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JOURNAL

OF THE

AMERICAN WATER WORKS ASSOCIATION

The Association is not responsible, as a body, for the facts and opinions advanced in any of the papers or discussions published in its proceedings

VOL. 8 JANUARY, 1921 No. 1

RELIEF FROM COAL SHORTAGE[1]

On October 8, 1920, the Interstate Commerce Commission issued Service Order 21, for the purpose of enabling railways to deliver coal for essential public uses more expeditiously than was practicable under prior orders. The wording of this order was, in part:

> That public utilities which directly serve the general public under a franchise therefor with street and interurban railways, electric power and light, gas, water and sewer works; also ice plants which directly supply the public generally with ice; also hospitals, schools and other public institutions of the United States, state or municipal governments, may be kept supplied with coal for current use but not for storage, exchange or sale. . . . .

On the face of this order, it did not permit railways to assist in relieving coal shortage at a municipal water plant, except by a rather severe stretching of the term "other public institutions of the . . . . municipal governments." In order to make sure that municipal water departments would receive the same aid as private water companies, President Little sent a letter on October 28 to the Car Service Division of the American Railway Association, the agent of the Interstate Commerce Commission in executing its emergency work to meet the coal shortage conditions. Following are extracts from this letter:

[1] Abstract of correspondence between Beekman C. Little, President of the American Water Works Association, and the Car Service Division, American Railway Association, Washington.

I am asking your coöperation and advice in devising some method whereby water works plants may obtain, not only as good service as the other public utilities may get, but the best possible and, perhaps, the first service in the matter of preferential coal supply in the coming months, when the situation may become very critical. . . . . If the water supply fails, not only is the greatest aid to fire protection gone, but all industries and the health and life of the community are threatened. If the failure continues for any length of time, disaster is inevitable and the functioning of *all* public utilities must cease.

I understand that your Committee has been designated as the agent of the Interstate Commerce Commission to be responsible for the delivery of coal to gas and electric utilities in the United States. . . . . The water companies have been given no special consideration and have, as you know, no representation on your Committee. This may be due partly to some unintentional oversight by those having the matter in charge and partly, perhaps largely, to the lack of initiative on the side of our water works engineers and managers, who too frequently take it for granted that all others, as well as themselves, realize the extreme necessity of the Public Water Works System and the utmost importance of keeping it constantly in commission. However, the reason for this particular neglect of the water utilities is of minor importance if the affair can now be immediately remedied. The American Water Works Association, with over 1400 members, representing water works plants in various cities in every State in the Union, asks your help and also proffers any aid in its power to bring about better assurance of future coal deliveries.

President Little's letter brought a letter dated November 2 from A. G. Gutheim, manager of the Public Relations Section, Car Service Division, of the American Railroad Association. This letter stated that for administrative purposes a distinction was made between utilities operated under a franchise, and other public utilities such as municipal water works. A committee has been appointed to look after the current needs of coal by non-franchise utilities and among its members are Col. D. B. Wentz, president of the National Coal Association, and W. L. Barnes, executive manager of the Car Service Division of the American Railroad Association, both of Washington. Applications for coal for immediate use, which cannot be obtained through usual channels, should be sent to either of these men. If there is evidence that the applicant is faced by conditions making special relief necessary, a certificate to that effect will be sent to the Interstate Commerce Commission for action by it. It must be kept in mind, however, that coal fuel is furnished in this way only for current daily needs and not for "storage, exchange or sale." The application should be accompanied by the information called for by the following data schedule:

Name of public utility or public institution (other than Gas & Electric Utilities).....

Address.....Date.....

1. Present stock of coal in net tons.....
2. Daily requirements (period ending March 15, 1921) in net tons.....
3. Annual requirements in net tons.....
4. Tonnage contracted for.....
5. Number of days required to move coal from mines.....
6. Percentage of daily requirements (net tons) shipped during last two weeks.....
7. Tonnage of coal reported now in transit.....
8. Kind of coal (gas or steam).....
9. Give description of any other fuels used.....
10. Can you adjust your requirements to use (a) mine run.....
    (b) lump.....(c) slack.....
11. Received by rail or water.....
12. (a) Name of contractor*.....
    (b) Period of contract.....
    (c) Location of mines.....
    (d) Original shipping point.....
    (e) Originating railroad.....
    (f) Routing to destination.....
    (g) What explanation does railroad give for inability to protect requirements.....

* Information required on each individual contract.

WHAT IS THE PROPER SIZE OF METER FOR MULTIPLE-FAMILY HOUSES?[1]

G. A. ELLIOTT:[2] It is difficult to lay down a hard and fast rule covering the proper size of meters for any service. The quantity and rate of use of water in any premises depend, of course, upon several factors, such as the character and number of the inhabitants, the number and kind of plumbing fixtures, the pressure, whether or not the supply is passed through a tank on the roof before reaching the house outlets, etc. It is almost axiomatic that the smallest possible meter should be used that is consistent with the demand of the service, not only to secure economy in first cost, but in order to measure the flow due to small leaks. The necessity for observing this rule was forcibly impressed on the writer several years ago, when it was discovered that several thrifty members of San Francisco's Chinatown had reduced the cost of water by dipping their supply from a barrel, which was kept full by a dripping faucet working continuously and registering practically nothing on the meter. Where the rate bill carries a service charge or a minimum charge based upon the size of the meter, the retention of the good will of the consumer demands that a small meter be used.

Since the metering of all domestic consumers in San Francisco, which was completed in 1918, a somewhat arbitrary rule has been used to determine the size of meter to be used on new services. It is based upon the assumption that under average conditions the entire use of water in a house takes place in a total time of not over 2 hours in the 24; that a $\frac{5}{8}$-inch meter will deliver without excessive loss of head, 8 or 9 gallons a minute, amounting to roughly 1,000 gallons in 2 hours, or 30,000 gallons a month, and finally that a six-family house as a general rule will not use over this quantity. Carrying out this scheme meters have been set as follows:

[1] Informal discussion at the Montreal Convention, June 24, 1920. Further discussions are invited and should be sent to the Editor. All of the discussion at Montreal is not reported in this issue, as some of the members taking part in it have not yet returned the corrected reports of their remarks.

[2] Written contribution read in the writer's absence.

SIZE OF METER	NUMBER OF FAMILIES	ESTIMATED MONTHLY USE
inches		*cubic feet*
$\frac{5}{8}$	1–6	4,000
$\frac{3}{4}$	7–10	7,000
1	11–18	12,000
$1\frac{1}{2}$	19–26	24,000
2	27–50	40,000

Although this arbitrary rule has apparently been satisfactory in that no unusual meter repairs have been necessary, it has been felt for some time that the quantity limit and hence the family limit could profitably be increased for the various meter sizes. A study of house uses was made with reference to the size of meter, which indicated that the existing rule could be modified. It was found in one case that 12,000 cubic feet per month, or three times the arbitrary limit, was being successfully passed through a $\frac{5}{8}$-inch meter, and that many instances existed where 6,000 cubic feet monthly were measured by a meter of this size. An interesting feature of the work appeared in the fact that there seemed to be no close relation between the number of families supplied and the quantity of water used. For instance, it was found that six-family houses used from 2800 to 6100 cubic feet monthly. At least one apartment house containing 22 apartments, all in use, was consuming only 4500 cubic feet per month, or less than was used by the six-family residences. The tabulation following may be of interest in indicating the practical difficulties of predetermining the size of meter based on any rule involving the number of families served.

FAMILIES IN HOUSE	MAXIMUM MONTHLY USE	MINIMUM MONTHLY USE
	cubic feet	*cubic feet*
2	3,600	400
4	6,400	1,200
6	6,100	2,800
8	6,600	2,900
12	19,000	4,500
16	18,900	9,400
20–25	23,700	12,500
26–35	24,900	7,300
36–45	34,900	15,500

Reference was made to the effect of the character of plumbing fixtures in fixing the size of meter, having in mind that certain

outlets require a comparatively large flow when in use, the flushometer toilet, for instance, which through the elimination of the tank requires a large service and meter, under ordinary pressure conditions. Many residences and small apartments are equipped with hose reels for fire protection, and these require large meters. On the other hand, a number of the larger apartment houses are equipped with storage tanks through which the entire supply is passed. In cases of this kind, a small meter operating over a longer part of the day than the use period will be ample for all needs. An example of this class which occurs to the writer at the moment, is illustrated by an apartment house containing 41 families which used 24,000 cubic feet in one month through a $\frac{5}{8}$-inch meter. It is of interest to note that of a total of 50,968 meters measuring the supply to purely domestic consumers in San Francisco, 50,864 are $\frac{5}{8}$-inch.

It is the writer's present opinion that, with pressures of 40 pounds, say, on the average, the following tabulation can be followed in selecting meters for use in multiple family houses, subject always to any known eccentricities in plumbing fixtures, or other features of the house requiring special arrangements.

Families	1–9	10–14	12–24	25–40
Meter	$\frac{5}{8}''$	$\frac{3}{4}''$	1″	$1\frac{1}{2}''$

W. R. Edwards:[3] Generally speaking, the ideas of the older water works man in planning and laying his main line pipe were opposite to those of setting a meter on the supply of a property occupied by a number of families or metering a business or commercial service. Evidently but little consideration was given to the ultimate results of putting down a main of such size as would only be sufficiently large for the immediate future. Now while he was almost certain to decide on too small a main, he has often decided on a meter too large, with the result that every expense thereto was that much greater in proportion, in addition to a certain loss in failure of registration of very small flows.

It may be that he could be excused both for laying the too small main, as expense was paramount with him, and the setting of too large a meter because of his meager knowledge of the performance of meters. His successor is not to be so readily excused, as he has had greater opportunity to learn and correct many of the shortcomings of the past, but we fear in numerous instances he has given but little study to proper meter sizes.

[3] Written contribution read in the writer's absence.

It is not uncommon today to look into the records of the average water department, and find that they have meters entirely too large to warrant their installation and maintenance. It was just recently that the East Jersey Water Company examined the meter records of one of its own water interests, so far distant from the main office that little attention had been given to it, depending to a large degree on the local management, and the inconsistencies found were only typical of what has been seen in a dozen other plants, both privately and municipally owned, viz., $\frac{5}{8}$-inch and $\frac{3}{4}$-inch meters doing two or three times as much duty as $1\frac{1}{2}$-inch and 2-inch meters.

The reason for this is that the size of the meter applied for was usually installed, or the size of the service connection was the controlling factor, instead of obtaining all possible information of probable consumption as a basis for decision. Be assured, no time is being lost in correcting this situation, and a genuine control of meter sizes will henceforth be maintained.

The report of another plant (municipal) just issued, which the writer happens to know considerable about, reports an increase in its revenue during the past year of approximately 60 per cent, due to giving the meter system a general overhauling, putting in condition the bad meters, and reducing the size of many others, thus getting a more complete registration of the water.

Reiterating one or two statements made in a paper which the writer read before the New York Section meeting on December 20, 1918, with respect to "Meter Oversizing," the 20 years experience in meter setting of the East Jersey Water Company has resulted in a definitely established schedule of sizes, and only under very special conditions does it deviate from this schedule.

In the early days of metering, the company became so well supplied with the larger sizes that it has been found unnecessary to buy a meter larger than $\frac{5}{8}$-inch in size in more than 10 years, and during this decade, no small number of manufacturing establishments, dye houses, etc., have become of record with the company.

That a wrong impression may not be conveyed, the following list of various size meters in service on January 1, 1920, is representative of the larger sizes in service 10 or 20 years ago, but of course the company maintains only the most modern types, which it has arranged for on a basis of exchange:

$\frac{5}{8}''$	$\frac{3}{4}''$	1″	$1\frac{1}{2}''$	2″	3″	4″	6″
26,573	519	210	66	63	23	19	5

Dealing with the metering of multiple-family houses, the East Jersey Water Company finds a $\frac{5}{8}$-inch meter adequately serves the requirements up to 6 families, each having a full or complete set of fixtures; $\frac{3}{4}$-inch meters serve 12 families; 1-inch meters serve 24 families; $1\frac{1}{2}$-inch meters serve 40 families or more. It is obvious that the company puts its meters to assiduous work, but they are fully equal to the task and when an analysis is made it is seen that they are not overtaxed in any way.

The average family, it is quite well agreed, consumes not in excess of 2000 cubic feet per quarter, and at this rate 6 families will consume 12,000 cubic feet per quarter, 132 cubic feet per day, and a further reduction equals 0.092 cubic feet or 0.69 gallon per minute, representing only $3\frac{1}{2}$ per cent of the safe maximum capacity of the average $\frac{5}{8}$-inch meter.

Of course, in dealing with domestic consumption, we must assume perhaps not more than 12 hours to constitute a day, which doubles the above figures, still we find 93 per cent of the capacity to spare.

We must make further deductions. Allowing for the period when the greatest demands are made upon the service, 20 gallons per minute safely delivered by a $\frac{5}{8}$-inch meter will certainly supply every need of the 6 families satisfactorily. If, by coincidence, all families require water to be drawn simultaneously, nothing more serious would take place than a momentary slacking of flow, which in all probability would never be complained of.

The writer lives in a 6-family apartment and has lived there before and after a meter was installed on the service and has had an excellent opportunity to observe its effect. There are a total of 33 persons in the house in question, and with a $\frac{5}{8}$-inch meter on the service, he has been unable to note any appreciable difference in the supply, nor has he heard a single complaint of poor service. As a matter of fact, he cannot recall that the company ever had a complaint of poor service to a 6-family house where the meter was found to be at fault, and the company serves a great number of such houses, all through $\frac{5}{8}$-inch meters.

It will be appreciated that with the $\frac{5}{8}$-inch meter performing as described, the other sizes mentioned work out in proportion.

When flushometers are involved, the East Jersey Water Company will not guarantee efficient service through a $\frac{5}{8}$-inch meter, nor will it install a larger size, but recommends an elevated tank to supply them, from which all the volume necessary can be had.

In metering commercial services, the company endeavors to install

the smallest size meter that will properly take care of the consumption, and where a large volume is desired only periodically, as in dye houses, the company calls upon the consumer to install a tank to serve the purpose.

In metering new supplies, practically all necessary information to determine the size of the meter to be set is furnished on the "Service Pipe and Meter Application Card," a sample of which is herewith furnished. Meters are frequently changed in size to meet new conditions, thus it follows that the sizes are kept well regulated.

REQ. NO.....

PASSAIC WATER CO.

The undersigned.....
request the installation of a Service Pipe and Meter for the furnishing and measuring of water to the premises known as.....
(of which he is the owner) and agrees to pay to the Passiac Water Co., the established meter rate for said water in accordance with the Rules and Regulations of the company and Rules and Regulations of the Board of Public Utility Commissioners, Dated February, 1917.

Signed.....

Size of service pipe from main to curb to be.....inch determined by data on reverse side as furnished by applicant and.....inch to house as ordered by applicant.

[OVER]

DATA AS SUPPLIED BY APPLICANT

No. of stories.....No. of families.....Size of plot.....
Rear house, stories.....No. of families.....
REMARKS.....

COMMERCIAL PURPOSES

Character of business.....
Steam-boiler-H.P.....Will well water also be used?.....
REMARKS.....

	Outside	Basement	1st floor	2nd floor	3rd floor	4th floor	5th floor
Water closets							
Baths							
Flushometer							
Beer motor							
No. of persons							

Dated.....*19*....

H. P. BOHMANN: In Milwaukee the size of meter selected depends upon the size of the connection with the street main. There is a rule that all meters must be of the same size as the corporation cock or branch connection at the main. Another rule provides that the minimum corporation cock for any service must be $\frac{5}{8}$-inch in size. Where the city extends the service pipe to the curb for future connection, the city inserts a $\frac{3}{4}$-inch corporation cock. For this reason most residences are supplied through $\frac{5}{8}$-inch or $\frac{3}{4}$-inch meters.

From an experience of about 35 years during which the city has installed many thousands of meters, it is evident that these sizes are am le for residences, as there have been no complaints which could be traced to inadequate meter capacities. Where a service pipe is extended to multiple-family houses, called duplex flats in Milwaukee, the size of meter installed depends entirely on the number of apartments. There are such buildings in Milwaukee with all the way from six to eighty apartments, supplied with water through services from 1 to 4 inches in size, with the meter size selected in accordance with the rule already mentioned.

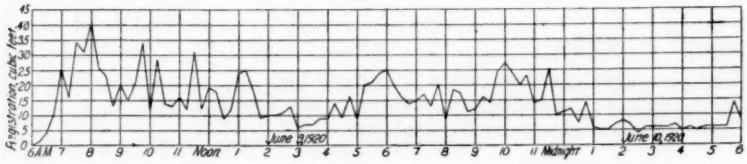

FIG. 1. REGISTRATION FOR 15-MINUTE PERIODS OF A 2-INCH METER ON THE SERVICE PIPE OF A 52-APARTMENT BUILDING IN MILWAUKEE

In some cases a 3-inch cast iron service pipe has been substituted for a 2-inch pipe because the latter is frequently very uneven. In such cases, the installation of a 2-inch meter on a 3-inch service has been permitted.

Quite recently, the speaker had readings taken every 15 minutes of the consumption in a multiple-family house with 52 apartments. This was supplied through a 3-inch service pipe with a 2-inch disk meter. The total consumption during 24 hours was 1334 cubic feet or about 10,000 gallons. The variations in the rate of consumption are shown in figure 1. The maximum rate was 40 cubic feet for a period of 15 minutes or $2\frac{2}{3}$ cubic feet per minute. Apparently the meter is over-size, as its rated capacity is 22 cubic feet per minute, but the speaker does not wish to draw any conclusions from one test.

Further tests on multiple-family houses of smaller size are proposed.

One reason the Milwaukee Department can contribute little information to this discussion is the long-established rule fixing the size of the meter. The meter is furnished by the consumer. Were the department to adopt a minimum size which proved later to be too small, making it necessary to ask the consumer to put in a larger meter, an embarrassing situation might be created. It is hoped that some day the city will furnish the meters, and in that case investigations will be made to determine beyond question the safe minimum sizes for the local conditions. But until that time comes the department must play safe and keep to its old rule.

JOHN N. CHESTER: The statement[4] that the Hackensack Water Company has no complaints from multiple-family houses served through a $\frac{1}{2}$-inch meter can probably be explained better from a sociological viewpoint than from that of hydraulics. In tenement houses occupied by the families of laborers, with a bath upstairs and a laundry tub downstairs, if an attempt is made to fill the bath while the kitchen faucet is running, there will be only a trickle of water into the tub. But the tenant has never known any other condition, does not expect both fixtures to discharge a full flow simultaneously, and so makes no complaint. But in a larger house, it is unlikely such a condition will be accepted without a protest. It is impossible to fill two baths simultaneously with any rapidity when the supply must pass through a $\frac{1}{2}$-inch meter. The speaker lives in an apartment house built twelve years ago, supplied with water through a $\frac{3}{4}$-inch service and $\frac{5}{8}$-inch meter from a street main under 90 pounds pressure. He generally rises fifteen minutes later than his friend sharing the apartment because it is impossible to fill two baths at once in this apartment. That is not good service for the class of persons living in such a house, and the Association should be careful to avoid endorsing any expression of opinion which will give the idea that such service is generally satisfactory. A $\frac{1}{2}$-inch meter cannot pass water rapidly enough to give good service for such an apartment.

The remedy seems to lie in the adoption of the service-charge or graded minimum and consumption-charge method of making out

[4] The reference is to a part of the discussion at Montreal which has not yet been returned in revised form.

bills. If the consumer is told that with a $\frac{3}{4}$-inch service and a $\frac{1}{2}$-inch meter he cannot get a good simultaneous flow of water from two fixtures, but he will have a lower water bill than if he chooses a larger service and meter giving good simultaneous discharge from two bath cocks, then he will have no ground for complaint if he decides to save money at the expense of good service. But in justice to him, if he is willing to pay for good service he should be given an opportunity to obtain it. The water works manager can help him decide what to do by going over with him the list of fixtures in the building and pointing out what size service and meter are needed to insure full simultaneous discharge from those fixtures which it is desired to have flow in this way.

A water company under the speaker's management has a peculiar condition in a district containing the summer homes of wealthy families. Some of these houses have as many as fourteen bathrooms, and when the owner wishes a 2-inch connection for such a residence he gets it. But after experience with this class of consumers, a compound meter is placed on every service larger than 1-inch. Such a meter requires a little more attention than a simple meter but it is a fairer meter to both water consumer and purveyor, where bills are made out on the basis of a service charge or graded minimum plus a consumption charge.

A different condition exists in the territory of another company with which the speaker is connected. In Pennsylvania and Ohio the water purveyor must deal with the water consumer, not the owner, unless the owner is also the consumer. The water company is perfectly willing to deal independently with each tenant in a multiple-family house, provided the owner will furnish means for measuring and controlling the supply to each tenant. If the owner will not do this, the company holds that the owner must act as the legal consumer. In large residential buildings of this type a 2-inch or $2\frac{1}{2}$-inch service is run from the main to a header, to which are attached as many meters as there are tenants, and independent risers run to each apartment.

The flushometer, which requires a large flow of water for a short period, will affect temporarily the supply to every consumer on a 4-inch main, but so far as charging for it is concerned the matter will be cared for by a proper service charge. As a matter of fact, flushometers are best adapted for use in a large building where an attic tank with a float valve can be installed to supply them.

H. F. DUNHAM: In discussing fixtures attention should be drawn to a principle in hydraulics called "equalization." At a meeting of this Association in one of our largest cities the late Emil Kuichling and the speaker found that principle in operation in one of the largest hotels in the morning hours of each day. As the pressure in the pipe system of the hotel varied it was equalized by the flow of water from bath tubs on one floor back through the pipe system to faucets and bath tubs on other floors.

We mused over it, as members of an Association enthusiastic over the fine, filtered water supply and critical of bathroom fixtures even to the refinements of color tints; and yet we were using the same water over and over with the variation in pressure in the hotel pipes. Mr. Kuichling said, "publish it in the technical press and all health officers will at once be active in ordering such fixtures torn out." The publishing was done but one doubts if it led to any radical change. At any rate such bath tubs are in use from the Atlantic coast to Oregon. High priced tubs too, "$90.00 each."

The whole subject should go over to the care of the last speaker. He knows about fixtures. He is in touch with the officials of many states. The case referred to above was in his state. The first tub of that type noticed by the speaker was in his own city. He can explain "all is not gold or silver that glitters" under water.

WILLIAM W. BRUSH: The subject under discussion is of great interest to operating men and has been talked about for a long time. Apparently the time has come when we can crystallize opinions more usefully by joint action than by the expression of individual views, and the speaker therefore moves that the President be authorized to appoint a committee to investigate and report on the proper size of taps, services and meters. This is committee work which will occupy many months and call for the cooperation of the members quite generally. But when it is finally concluded, as it probably can be, then the findings will be most helpful in dealings with Public Service Commissions as well as with water consumers. There is hardly a member who is satisfied with all the methods he is following in determining these sizes, and probably the difference in practice is even greater than that expressed in the discussion today. Under such conditions, real progress toward standardization can best be made by the steady, continuous work of an open-minded committee.

The motion was seconded, put to vote and carried.

J. WALTER ACKERMAN: Where a water bill is made up of a service charge and a consumption charge, the selection of the size of service and meter by the owner practically makes him responsible for deciding whether or not he wishes to pay the cost of providing adequate pipe capacity to draw large quantities of water quickly. The conditions in some large residences are duplicated by that in laundries. The latter desire large quantities of water quickly but do not wish to provide overhead tanks which fill slowly between these times of heavy sudden demand. By adopting the service-charge method of billing, the consumer must decide what he wishes to do, and the water department or company is not compelled to make a considerable investment to supply large occasional demands for water which, however, amount in the aggregate to a quantity that could be supplied satisfactorily through a smaller service pipe and meter under ordinary conditions of consumption.

WILLIAM F. SULLIVAN: Where there is no law requiring the water department or company to deal with the consumer and not the landlord, such as Mr. Chester mentions, it seems probable that the use of one service for a multiple-family house, is the simplest method of supply. It works satisfactorily in the case of the Pennichuck Water Works, where it is assumed that the tenant is the customer but the landlord is held responsible for the payment of water bills by the tenant. It is unlikely that the average landlord will regard with favor running a separate pipe to each apartment in a building, on account of the network of piping in the partitions and the cost of the installation. It is apparently much simpler to supply the house and let the landlord meter the supply to each tenant. It is cheaper for the tenant also, for under the plan of a wholly independent service for each tenant he will be charged the usual minimum if he is careful, whereas if he pays his landlord he will probably secure all the water he needs for a smaller sum.

As an illustration, take the supply for an ordinary sixteen-flat house. To run a suitable service into the building and there install a header with sixteen meters connected with sixteen independent risers seems a very cumbersome arrangement. The construction is complicated, the meter reading is complicated and the accounting cost is increased, and the result is no better than to put a meter on the house service and let the landlord sell water to his tenants as he thinks best.

W. Z. SMITH: For several years, the Atlanta Water Department has been making an investigation to ascertain the proper size of services for multiple-family houses. The conclusion has been reached that in the majority of cases, the tendency has been to put in larger meters than is necessary. As a result, something like 200 services have been changed. In one case, a 6-inch meter was found in use where the maximum demand made a 3-inch meter of ample size. The change to the smaller size meter was made, and the improved registration of water by this smaller meter resulted in an increase of 80 per cent in the receipts for water through this connection. In the case of a family hotel with more than 100 families, the owner made application for a 4-inch service. The department allowed the service of this size, but placed a 2-inch meter, using about 10 feet of 2-inch pipe in setting it. The owner ran a 4-inch pipe for a distance of about 100 feet from the meter to the boiler supplying hot water in the building. A little further along, this 4-inch pipe terminated at the foot of the $2\frac{1}{2}$-inch cold-water pipe. There has been no complaint of an inadequate supply nor has the meter required a greater maintenance expense than others of the same size.

Another instance of the same kind is the case of an apartment house occupied by fifteen families. This is supplied through a $\frac{3}{4}$-inch service and a $\frac{5}{8}$-inch meter, from which a $1\frac{1}{2}$-inch house connection runs from the sidewalk to the building. There has been no complaint of insufficient supply here. Another oversized meter was found on a connection to a newspaper building. The department took out the larger meter and substituted a smaller one, with the result that instead of collecting about $60 a month from the service the department is now receiving from $90 to $130. In another case, a 4-inch meter supplying a railroad company was replaced by a 2-inch current meter, resulting in an increase in the monthly bill from $250 to $325.

The Atlanta Water Department has received similar complaints to those referred to by Mr. Chester, in which the consumer stated that he could not get sufficient water for the bath supply while water was being drawn in other parts of the house. It is the custom in Atlanta on such complaints, to have a flow test made to see whether the trouble is in the meter, service, or house plumbing. The service pipe is disconnected at the sidewalk and allowed to discharge into the gutter, so as to obtain a measurement of the free discharge of the meter under the pressure in the main. The service is then

reconnected and the fixtures in the house opened up one at a time, until the full capacity of all of them is reached. In making this test, a portable recording gauge is attached to the service pipe before it reaches the meter, and another gauge is attached to the house pipe inside the building. The test frequently shows that the true remedy is to increase the diameter of the service pipes inside the premises, it being found that the friction loss in a long $\frac{3}{4}$-inch pipe or through an old service pipe is the cause of the lack of pressure. These conditions are often duplicated on a large scale in the supplies to industrial works. In one particular case, where a 12-inch meter was desired, the department insisted on an enlargement of the pipe in the property, and were enabled with this change to supply all the water desired through a 6-inch meter.

Another part of the house plumbing which is often found responsible for loss of pressure is the stop-and-waste valve, with an opening smaller than the bore of the pipe. Sometimes the opening in such valves is square instead of round, and it is not uncommon to find a $\frac{1}{2}$-inch cutoff valve with such an opening on a $\frac{3}{4}$-inch pipe. The reduction in pressure due to such a valve is very great.

ADOLPH MUELLER: Some reference has been made to cocks which did not have their nominal water passage. The brass goods manufacturers looked into that matter and found from an inquiry among over forty makers that not one made a $\frac{3}{4}$-inch compression stop cock which was full size. The $\frac{5}{8}$-inch cock was usually $\frac{1}{2}$-inch actually and the $\frac{3}{4}$-inch was generally $\frac{5}{8}$-inch. As a result of the investigation and the discussion following it, the manufacturers have recently agreed to make compression stop cocks having an opening equal to that of the pipes on which they are used.

THE BUSINESS END OF THE WATER WORKS[1]

By O. E. Clemens[2]

In this brief paper on the commercial features of the water business the purpose is to give an account of the experiences of the Spring Valley Water Company during the past three or four years. The author will not enter into a discussion of the methods of securing business, of developing more business through increasing uses of water or of meeting competition. The subject is a more human and, in a way, a more interesting problem, the overcoming of a deeply rooted prejudice against water meters; of the education of the consumers to the principles of equitable payment for service rendered and the value of the commodity used; of the training of the individual in the proper uses of water with a resultant reduction in gross daily delivery that has saved the city from a disastrous situation; and how the company made friends of former corporation baiters and made boosters of knockers.

Universal metering and company policy—The Spring Valley Water Company has some 20,000 commercial accounts consisting of factories, refineries, shops, railways, stores, hotels and apartment houses, and over 50,000 residential accounts represented by family dwellings consisting of houses and flats.

The commercial consumers have always paid for water service on a measured or meter basis. Prior to October, 1918, the residentials were assessed on the so-called Flat Rate schedule, this being based on the size of the house, number of fixtures installed and the area of the garden and lawn. The revenue derived from this source averaged up fairly well as a whole, but was sadly discriminatory and unjust as between consumers. More than half of the residential consumers paid from 25 to 100 per cent more than the value of the water they used, the remainder paying less, many of them using

[1] Read before the California Section November 13, 1920. Discussion is invited and should be sent to the Editor.

[2] Water Sales Manager, Spring Valley Water Company, 375 Sutter Street, San Francisco, Calif.

and wasting from 10 to 100 times as much as they paid for, as was proved by the records of test meters installed.

When the company began installing meters on the residential services during the summer of 1916 (these being set primarily for test purposes, as meter rates could not be applied to this class of consumers under the then existing ordinance) it met with a wave of opposition which was intensified by the radical elements, aided and abetted by a certain daily paper, which was in fact actuated more by personal animus than by any desire to serve the public.

Application being made to the Railroad Commission in the early part of 1918 for a uniform rate schedule, the company rushed the installation of meters, having the entire fifty thousand set by October, 1918, when the Commission authorized the application of a modern and most equitable rate.

After two years of intensive educational and service work, the public is now thoroughly converted to meters and we can state with the utmost confidence that if the question should be put to vote, those in favor of returning to the former system of billing for water service would be hopelessly in the minority.

In addition to the gratification of having a satisfied public to deal with, the company has saved in the neighborhood of 10,000,000 to 12,000,000 gallons of water daily by the elimination of leaks and waste. This knowledge has produced a most comfortable feeling during the past year, a year of water shortage so serious that it affected indirectly all lines of business in the State of California.

In working out the problem of meeting the opposition and old-time prejudice, the company just used common sense—got the other fellow's viewpoint and met him on his own ground.

The keynote of the campaign has been and is yet "Education and Service." By "Education" is meant not only the education of the public but also of the Company's employees as well. To all, whether the individual encountered is salesman or collector, service man or adjuster, railway ticket agent or conductor, Government postman or stamp clerk, the opinion formed of his company or institution is very largely based on his personal service to us. If he is arbitrary and a boor, uncouth or ignorant, we will receive a very poor impression of the people he represents. To the contrary, if he is gentlemanly, gives us the opportunity of airing our own opinions, can give an intelligent and logical explanation of the question in hand and is fair enough to admit an error and correct it, he at once

commands our respect, with the result that his company goes up several points in our estimation. And when opportunity comes to say good or ill, the chances are that we will give his company the best of it.

Acting upon this idea, not a theory by any means, for it has been established as a fact, the Spring Valley Water Company promptly proceeded to educate its employees first of all. Classes were held at the shop where they were shown the workings of the water meter, shown what a wonderfully accurate instrument it is and how seldom it can get out of order; how if it does go wrong, it is almost invariably in favor of the consumer. The time spent on this was well worth while, for the men gained full confidence in the instrument and could meet any and all comers on the subject. And many men were found in this city, otherwise very intelligent and well read, who possessed a blind and unreasoning prejudice against meters and honestly believed they could not be depended on for accurate registration.

The next step was to drill the company's personnel in the logic of the new rate schedule. This schedule is one that at first aroused much adverse comment, owing to the elimination of the familiar "minimum bill" and the substitution of the "monthly service charge," an item independent of the charge for water delivered. As this method of billing is a radical departure from the established custom, it may be well to give a brief explanation of the principles involved:

In the supplying of water there are three distinct operations, the costs of which must be borne by the consumers:

1. Developing and protecting the water at its source, collecting it in large storage reservoirs, and pumping and conveying it to the city distribution reservoirs.

2. Distributing the water throughout the city through the main supply lines to the smaller regulating reservoirs, and finally through the distribution lines in each street.

3. Maintenance and repairs to meters and services, inspection of plumbing and fixtures for the consumers, reading meters, bookkeeping, billing and collecting.

The charge for "water delivered" is based on the cost of the first two items, which cost includes proper returns on the value of the properties involved, depreciation and maintenance. The charge for "water" in San Francisco ranges from 24 cents for each 100 cubic feet for domestic and small commercial consumers to 18 cents

per 100 cubic feet for large industrial consumers. The reason for this distinction is that it costs relatively less to distribute water in large quantities than in small quantities.

The "monthly service charge" is based on the cost of the third item, which is largely the expense of the "sales" or "commercial" part of the business. The total charge as fixed for this item includes all items of expense beginning with the consumer's service line; and in addition the estimated cost of the water passing through the meter without being registered. This is known as "slippage." It amounts to a very considerable item, tests showing that the average is about 50 gallons per day on the standard $\frac{5}{8}$-inch household meter and proportionately more on large meters. The total service charge as now fixed is 65 cents per month for $\frac{5}{8}$-inch meters, increasing through intermediate charges to $40 per month for the large 8-inch connection.

The service charge is a most equitable arrangement. It is fairer than the "minimum bill" method. The Railroad Commission, after thorough consideration of the principles involved, said in its decision authorizing the company to apply the new schedule:

> The minimum charge is invariably higher than the service charge, and it involves the payment by each consumer for a fixed amount of water regardless of whether or not he uses it. There is no answer known to us which can be made to the man who complains that under a minimum rate he is compelled to pay the same amount for 100 cubic feet of water as his neighbor pays for 300 or 400 cubic feet of water, depending on the amount fixed for minimum use.
>
> We believe that under the conditions of service we are dealing with herein the service charge once established and thoroughly understood will be agreed to as the fairest and most equitable method of fixing rates.

The service charge is not an additional charge and does not mean higher rates. It is simply a different and more equitable way of distributing the cost of service among consumers.

In the education of the public at large, the company did not depend on the personal contact of its representatives. This, while good, was too slow a process. What the company wanted was results and it wanted them quickly. To meet this it went into the press with paid advertisements. It not only took space in the big dailies but also in the district newspapers, for these all have their sphere of influence and followers. It did not take up this phase of the work in a half-hearted and hap-hazard manner either. Newspaper

space costs good money and badly written and undigested advertisements are very poor investments. Like the other spokesmen for the company, its advertisements are taken as indicative of its attitude towards the public.

The publicity was put in the hands of an expert, a master of good English, one who could get to the heart of the subject and develop the human interest side of the question. The advertisements told the story in simple and effective language. The "whys" of metering were given. The new meter schedule was explained and arguments made against it by consumers were reproduced and answered. The causes of large water bills were enumerated and specific cases of cause and cure cited. The square deal was constantly preached—and lived up to by the company's operating forces. The public was invited to come to the company with its water troubles and to call on its service department for assistance.

The advertising was backed up by real service. All complaints, no matter how trivial, were thoroughly investigated and helpful letters sent out to the complainants. Defective fixtures were located and specific recommendations regarding repairs were made. Unnecessary and wasteful uses were pointed out and constructive criticism offered. As a result, instead of an office full of irate consumers with the figurative "blood in the eye" and "chip on the shoulder" attitude and a host of insulting letters in every mail, the company have only relatively few complainants at the information and adjustment window; asking, not demanding, an investigation of abnormal bills and leaving to the company entirely the question of the adjustment of the cost of water lost through the leaky fixtures. And hardly a mail delivery comes but it brings one or more letters of appreciation from pleased consumers. It would be possible to talk for hours of the work done in helping the public to an economical and sane use of water and to relate many varied and interesting stories of contact with consumers and the queer and wasteful methods uncovered. But these stories have no place here.

The company has made over 30,000 inspections during the past two years; it has found 10,000 defective toilets, located thousands of leaking faucets, and hundreds of broken or cracked house pipes. It has also shown many large consumers, such as hotels, candy factories and the like, how to save from a fourth to a third on their bills for water. It has trained thousands of families in the proper and liberal use of water without wasting, not only for the house-

hold but for irrigation purposes. They have learned that plenty of water can be used in the home without making the meter work overtime; that a bath is not an expensive luxury, for it costs less than a cent; that in San Francisco 3 cubic feet of water per square yard per month during the summer will keep the lawn green and the garden blooming on the sandiest of sand lots. The company has also taught them that a defective toilet or a carelessly used or forgotten garden hose can waste more water in a day than an ordinary family can use legitimately in a month.

The results accomplished and the good feeling developed have repaid a hundred fold the energy and money expended on this educational and constructive campaign. Aside from the tremendous saving of four billion gallons of water a year, previously wasted and benefiting no one, it is possible to point to concrete savings in operating expense, largely attributable to the changed attitude of the public and its wholesome effect on the morale of the company's employees.

The pumpage quantities are less. There is less malicious damage to equipment. Patrons now go out of their way to telephone, write or call at the office regarding broken services or leaks in mains. The claims on account of damages to goods in basements flooded by an occasional break are now more easily adjusted; very seldom does anyone try to hold up the company or get the best of it. Collection expense is less and losses through bad accounts are negligible; last year they were 0.1 per cent and this year they will be even less.

In the final analysis the company knows its policy has paid and will continue to pay.

Departmental organization and methods.—The operating organization of the Spring Valley Water Company consists of three distinct departments: (1) The Water Division, which looks after all the water development properties outside the city and delivers the water to the city reservoirs. (2) The City Distribution Department, which constructs, maintains and operates the San Francisco system, including all pumping plants and reservoirs within the city. (3) The Water Sales Department, which handles the commercial section of the business. The details of this organization and methods will be discussed later.

All active water services in the system are metered, including temporary services used by contractors on construction work and all private fire services to theatres and large buildings. The only water taken and not recorded on meters is that used by the city for

fires, for flushing and for street sprinkling from street hydrants, a small amount used from hydrants by contractors on street work and that supplied the coast and river steamers at the water front from the open wharf hydrants.

The city fire and sewer flushing uses are covered by the hydrant charges. That taken for street sprinkling, for street construction and by certain vessels at the docks is billed on the estimated quantities at rates authorized by the Railroad Commission.

There are approximately 72,000 active services, through which the company delivers to the consumers in the city some 30,000,000 gallons daily, measured at the service, producing $4,000,000 annual revenue. Of the water delivered at the service of the consumer about 18,000,000 gallons go to commercial consumers, 10,000,000 gallons to residential consumers, 1,000,000 gallons for municipal uses other than for fire fighting, 750,000 gallons to the ships and 50,000 gallons to contractors on construction work. The difference between the measured delivery of about 29,500,000 gallons daily and the delivery to the city reservoirs of 36,500,000 gallons, amounting to 7,000,000 gallons, or 19 per cent, is accounted for by fire uses, evaporation, main and service leakage and flushing of the mains and sewers.

Water sales organization. The Water Sales Department consists at present of 113 people, 92 men and 21 women and girls. As the company is now operating under changed conditions, a comparison with the records of the month of October, 1915, when all residential services were unmetered, will be of interest. These are produced herewith:—

	OCTOBER, 1915	OCTOBER, 1920
Active consumers	66,000	72,000
Daily delivery to city reservoirs (gallons)	45,187,000	36,566,000
Gross revenue	$298,391	$331,124
Meter readers	9 (⅔ time)	13
Shut-off men	7	4
Plumbing and rating inspectors	19	8
Bookkeepers and billers	14	28
Addressograph room	3	2
Field collectors	24	21
Builders and contractors supply	7	1
Dock and shipping supply	4	4
General office assistants and clerks	32	32
Total employees	119	113

The smaller force now maintained handles a larger business than the company had in 1915 and gives the public far more satisfactory personal contact. This reduction in the force and the delivery of a higher standard of public service is due partly to the reorganization and re-alignment of the department; partly to the 100 per cent metered condition of the business; partly to improvement of some methods, the elimination of others and the introduction of new methods. In addition credit must be given to the changed attitude of the public, which has been meeting the company in a coöperative way, this greatly improving the morale of the employees and indirectly increasing their efficiency.

Methods and system. Of the 75,000 active and temporarily non-producing meters in San Francisco, 3,500 are installed in the basement areas under the sidewalk in the downtown section, the remaining 71,500 being in the open along the curb line in the sidewalks.

All meters are read once a month, the entire city being covered by 13 readers in 21 working days. The average on the basement work is from 100 to 150 per day, in the semi-commercial district where they are delayed by traffic, merchandise on the sidewalk and other handicaps, about 250 or 300 per day, while in the open sections, solidly built, they average better than 500, some runs reaching 700 in seven hours reading time. The average throughout the month is 300 per day per man for the 21 days.

On the five remaining days of the month the men take "covered" readings, clean dials and work up reports on broken boxes, and on the last day take the municipal and corporation readings.

The meter readers use a canvas-covered, loose-leaf field book of the steel tape type, holding sheets $4\frac{1}{2}$ x 7 inches, having a capacity of two years' records. These sheets are crimped at the lower or binding edge, permitting them to lie flat when the books are opened. This feature is quite an advantage to the reader and especially so to the ledger posters and billing machine operators.

These books, each one covering a man-day route, are turned over by the chief of the readers to the head bookkeeper each night. These are recorded by him on a schedule sheet on which a record is kept of the various operations until the completed bills are turned over to the Collection Department.

The consumers' ledgers are of the same loose-leaf, steel-tape, crimped-sheet type, each ledger holding from 500 to 1000 accounts, each sheet having a capacity of four years' records. On these

sheets is carried the full record of the account, showing name, address, account number, meter number and records of changes, together with any and all records of Turn-ons, Shut-offs and Allowances.

The meter readings are posted on the ledgers, computations made and after a memorandum of unpaid balances due is made on the meter sheets they are turned over to the billing machine operators.

The bills used are of the single bill type, with an office memorandum stub and remittance stub. The company does not send receipts for mailed remittances except when demanded. The consumer retains the body of the bill and encloses the stub with his check. When bills are paid in the office or to the collectors, the body of the bill is receipted and returned to the consumer, the stub being turned in with the collector's cash. The credit postings are made on the consumers' ledgers by a night crew of three men.

The form of bill now in use was adopted after investigation of the bills and methods of a dozen large utilities. The company believes it has as sightly, economical, accurate and convenient a bill to handle as any produced. It is less cumbersome than the duplicate bill, requires only one half the amount of paper stock and eliminates carbons. The number of bills rewritten on account of being misplaced by consumers is negligible, less than 1000 per month out of nearly 75,000, so this argument against the single type of bill is eliminated.

After the bills are written they are checked against the ledger record and errors in entry and computation corrected, then passed on to the Collection Bureau. There they are sorted, the mail bills turned over to the mail clerk, the bills to be paid by the realty agencies are assembled, and the others put in the street boxes or racks. These are re-assembled each day according to routes and given to the Collectors that evening so they can start direct on their routes the next morning without losing time in coming to the office.

The mail bills are placed in a special window envelope made to fit the bill with attached stub without folding. This is a material advantage, as much time is gained by avoiding the folding of the bill before inserting it in the envelope.

There are 14 collectors on the regular field work, following the same route covered by the meter readers and completing the city in 24 working days. One collector handles realty agencies and downtown bills, and six men are on followups, closing bills, contractors' bills and bad bills. They are also in reserve to fill in the vacancies due to sickness, vacations and miscellaneous emergencies.

Of the 73,000 monthly bills, 4.5 per cent are held at the office for the consumers, 7.5 per cent go to realty agents for payment, 10 per cent are mailed to the consumers and the remaining 78 per cent are presented by the collectors. The company encourages mailing of bills, especially in sections where it can be made universal. The collectors bring in the money for two-thirds of the bills presented by them, the remaining third being sent or brought to the office or secured by the follow-up or "second-line" men.

The cost of field collections, on bills actually collected, averaged during the year 1919, 2.03 per cent or 6.96 cents per bill as against 2.24 per cent or 8.37 cents per bill in 1917, although wages in 1919 were higher. This is due to the reorganization and to the change of public attitude referred to before. The follow-up, closing account and bad bill collection expense is considerably more, from five to ten times as much. But the company can afford to spend some money on this, as losses from delinquent accounts may become a very serious item if they are loosely handled. While the company is very liberal with regular customers and with those out of work or sick, it will gladly spend the entire amount of the account, and more if necessary, to collect a bill from a crook or a chronic dead beat. The moral effect of this procedure on this class of individuals is good. It also adds zest to the game and keeps the force keyed up to a proper spirit and on its mettle.

VALUE VERSUS INVESTMENT AS A BASIS FOR UTILITY SERVICE RATES[1]

By Wm. G. Raymond[2]

The commonest method heretofore adopted by courts in valuing utility properties has been the so-called cost-of-reproduction-less-depreciation-plus-going-value method. For the purpose of this discussion it is sufficient to speak of "cost of reproduction." When changes in prices yielded a wavy line up and down above and below a fairly horizontal average line parallel to the axis of years, in a diagram, it made comparatively little difference whether original cost to date or reproduction cost was used as the basis of value.

Properties usually being built piecemeal, the actual investment would be made partly in times of high prices and partly in times of low prices, so that the original cost would tend to be a better basis of value than a reproduction cost, for it would reflect the effect of prices averaged over a period of years. A reproduction cost estimate made during a period of low prices would deprive the owner of somewhat of his investment, whereas if the estimate were made during a period of high prices something would be added to the investment. Rates for service, being based on either one, would be likely soon to become inequitable because of the certain change in costs either up or down that would follow soon after the valuation.

Valuations made every few years would be likely to be made sometimes during high prices and sometimes during low prices, and so the general average might not be far from fair if made on a reproduction basis. But it would seem to be plain that during a considerable number of years preceding the recent war, original cost to date, actual or estimated actual reasonable investment, was likely to give a fairer basis for determining value than reproduction cost.

[1]Read before the Iowa Section, November 6, 1920. In this paper "investment" means the actual or estimated reasonable cost of creating a return-earning utility property; it is expressed in money. Discussion of the paper is invited and should be sent to the Editor.

[2]Dean, College of Applied Science, State University of Iowa, Iowa City, Iowa.

Now the situation is changed. Prices are decidedly higher than before the war, and what seemed to be fair then may be questioned now. The reproduction costs of certain utility properties are now nearly or quite twice the original investments made prior to the war. What shall be done now? Is reproduction cost the fairest basis of value now? Or is original actual or estimated actual reasonable investment still the better basis?

It is asserted with some confidence that the real investment, as nearly as that can be obtained, is still the fairest and best basis for rate making, and that such allowance as must be made for the changed conditions should be in the rate of return.

These properties last for many years, during which there may be great fluctuations in costs of construction, and the one stable thing is the investment. It would seem to be the logical thing on which to base rates. But the return rate should vary with considerable or long time variations in costs and the worth of money. An attempt will be made to point out some difficulties and inequities that result from varying value with varying cost prices. Depreciation accounting will be used for this purpose. Assumptions made will be violent for simplicity of computation. Effects of the application of principles will be emphasized by this procedure.

Let an investment of $100,000 create a property. Let the depreciation allowance that should be included in annual operating expense and credited to depreciation reserve be based on the cost (or investment) and be such as to provide a sum equivalent to the cost of the physical property when it is retired, varying sums for varying items. Let a particular item costing $100 be considered to be the only depreciating item. Let it be assumed that within the first year, before an annual charge for depreciation is made, in connection with a rate case a court, finding costs doubled as they are right now, places a value of $200,000 on the physical property, increasing the value of the particular item to $200. A few years later the $100 item goes out of service while prices are still high. It will require $200 to replace the retired item with another like it.

If the item has lasted its estimated life, there will be, in accordance with the assumptions made, $100 in the depreciation reserve either in property or cash, to reimburse the owner for his outlay now used up in the service of the public. But the court has raised the value of this item to $200. If this $200 is charged off, the owner loses $100 of the value the court has given him, and to bring the value back to

$200,000 he must find $100 of new capital to add to the $100 in the reserve, with which to purchase the replacing item. When the item is in place the value of the property stands as before at $200,000, but the owner has had to invest $100 more than his previous investment to maintain the value of that investment as fixed by the court.

On the other hand, as an accounting matter, let the process be as follows: After the decision of the court the property value is written up 100 per cent to $200,000. When the item considered is retired, $100 instead of $200 is written off, leaving $199,900 in the property. Then the new item is added and $200 is written on. The result is a property value of $200,100 or the value given by the court plus the extra $100 of new capital invested by the owner. The owner is protected in his value as fixed by the court and his additional investment. And yet we have exactly the same property that was recently valued at $200,000, now carried at $200,100.

Something seems to be wrong with both of the foregoing results and there are those who say, "Why, of course, the depreciation allowance should be based on the reproduction cost, the cost of the replacing item, not that of the original item." Let this be assumed to be true, and for simplicity let it be assumed that the higher cost of the replacing item is known in advance so that at the time the old item goes out of service the cost of the new item has been accumulated in the reserve. The situation will then be as follows: When the court raises the value to $200,000 the property will be written up 100 per cent. When the item under consideration goes out of service, its new value of $200 is written off, and the cost of the new item $200 is written on, the whole $200 being found in the reserve. No new capital is needed to maintain the $200,000 value of the property. This seems to be just as it should be. But what has happened and what is going to happen from now on? The original item cost the owner $100; the depreciation reserve collected from the public amounts to $200, sufficient to purchase the new item; so far as this item is concerned, then, the public will be called upon not only to pay interest or return on the appreciated value fixed by the court, but also to give the owner the actual cash representing this appreciation, which it has done by its payment in operating expense to the depreciation reserve, and thus contribute capital to the enterprise and pay a return on its own contribution. This certainly seems not right.

The foregoing examples seem to show the inconsistencies attending the handling of depreciation allowances in connection with legally

determined values based on a reproduction cost and a permanently rising market. What happens with a falling market that is to be experienced in the reasonably near future and is even now in evidence?

It will be assumed first, as before, that depreciation allowances to the reserve are based on original cost. It will be assumed that a property costing $200,000 is almost immediately valued by a court on the basis of reproduction, at $100,000, the one small depreciating item that cost $200 being valued at $100, and the replacing item is to cost $100.

When the original item goes out of service, either $200 or $100 is to be written off and the cost of the new item, $100, is to be written on. The sum of $200 has accrued in the reserve paid in by the public through charges to operating expense. Then the transaction may be as follows: When the court renders its decision the property is written down 50 per cent to $100,000. When the item considered goes out of service, its cost, $200, accumulated in the reserve is written off, leaving $99,800 in the property. The cost of the new item $100 is then written on, leaving the property statement at $99,900 physical property and surplus of $100 transferred from the reserve, making a total of $100,000. But the surplus may be distributed to the owner, and to essentially the same property that the court valued at $100,000 there will then attach a value of only $99,900.

If only the reduced value of the item, $100, is written off and the cost, $100, of the new item is written on, the property remains at $100,000 value, but there is still $100 in the reserve that may be distributed to the owner.

Now if the reserve had been established on the basis of the cost of the new item, then only $100 would be in the reserve; $100 would be written off for the retired item and on for the new item and there would be no disturbance in the accounts, but the owner will have lost half of his original investment.

Perhaps this is not more than he should expect after such a fall in prices as must have occurred to make the reproduction cost half the original cost. His loss occurred when the court made its ruling. But he would have lost nothing if he had put his money in a savings bank, and it seems hardly fair that the investor in a *permanent* public service property should lose a considerable part of his investment made in good faith and *of necessity* in a time of high prices, as is the case just now with all of the necessary extension work going on, any

more than it seems fair that the public should contribute capital to the enterprise when costs advance and then pay return on that capital.

Indeed it seems unfair to both public and owner alike that the value of a property used to give a public service should depend on the market price of the items, material and labor, that have entered into its composition. It is not these items that the company owner is selling, it is service that these items enable him to render that he is selling. As this service costs more or less, the charge for it should be more or less; as the value of the dollar changes, the rate of return on the investment should change.

The Interstate Commerce Commission in dealing with the railroads avoids in part the difficulties discussed above, by causing the public to pay the increased or decreased cost of replacing items by its contribution to operating expense but requiring the public to pay return only on the original investment. Thus if an item is purchased originally for $1000 and on being worn out is replaced by an identical item costing $2000, no change is made in the capital account, but operating expense is charged with the whole $2000. Perhaps this is the best that can be done with such complicated properties, and particularly with such items as ties, which could be segregated as to cost only with great difficulty and then only approximately, but it is not right. The public should not supply part of the cost of the property even though it does not bear the added burden of paying return on what it has furnished. Neither should the public pay a return on original cost when through the result of making replacements on a falling market the actual investment in a given property is much less than its original cost. The public should pay always as nearly as possible, a fair return on the actual reasonable investment, and should make the investment good as the items purchased are consumed in service. The investment is the one thing that can be handled by book-keeping methods without doing injustice to either utility owner or the public he serves.

Beside the depreciation allowance difficulty, the following considerations are thought to be pertinent:

It is not value that determines return nor can it ever be, it is return that determines value and this is not a quibble over words. The Supreme Court of the United States has said that a public utility owner is entitled to a fair return on the fair value of the property that he devotes to the service of the public. This is the law just now.

To the layman it seems like good law, but it is very difficult of interpretation and administration. Interpretation and administration would be much simpler and more satisfactory if the court had never formulated the law in the precise words that it has used, but had laid stress on the other law that it has established, namely: that the utility is entitled to charge for its service only so much as the service may be reasonably worth. The two laws must be in harmony or both cannot be law. If in interpreting and administering the law, fair rates are based on worth of service, and this in turn is based on cost to the community served to serve itself with the same plant as the one that may be under consideration and with reasonable efficiency, there will be little ambiguity, little difference over what to include in cost of reproduction, little difference of opinion about going value, a term that never would have been born, little difference about depreciation. The only thing to give the court much trouble would be the fair rate of profit to be earned, and this is purely a judicial matter. Most of the difficulties of valuation would have vanished, because when a community is serving itself with a physical plant, it is investment, not cost of reproduction that is considered. And investment does not change from day to day, or year to year, with changes in the cost of the items entering into the construction of the service plant.

Just now prices of all consumable commodities are high. Interest rates are high. Economists tell us that the causes are not the same. But the effect is the same, and all service of every kind is just now worth more than formerly because it costs more dollars, and because he who renders service must have more dollars for his living in order to have the same living as formerly, and because the use of the service in industry brings more dollars to the user than formerly.

If I make my living by the rental of houses that I own, I must increase my rental rate because all of my expenses have increased in dollars. My investment remains as it was in 100-cents dollars, but I must earn a higher rate of return on it. In fairness I am not entitled to the higher rate on an arbitrarily increased value assigned to my investment based on 50-cents dollars. I can't increase the value of my investment by the amount of changes in the purchasing power of the dollar and charge a rate of return on that increased value which also reflects the change in the value of the dollar. It makes no difference whether the causes of high prices and high interest are the same or not. My investment is only half what it was in purchasing

power and I must have twice the rate of return on this half to provide my living expenses; to make me the same living that I enjoyed before the war. In fairness I am entitled to no more from the source named.

What must happen is that I must have as many bushels of potatoes, if potatoes are my diet, for my rentals as I had before money became cheap. If potatoes now cost twice as much as they did, I must have either twice the rate of return on my investment or the same rate of return on an arbitrarily increased investment value. But I do not need both twice the investment value and twice the old rate of return on this inflated value. It is useless to say in opposing this statement that one's needs do not govern his legitimate profits in business. It is impossible to treat a public utility property just as if it were a freely competitive unregulated enterprise. And it must not be forgotten that charging unreasonable profits in any business connected with the necessities of life is contrary to public policy.

On a new investment made now, I must have the high rate of return because these dollars that I am now investing will buy only half as many potatoes, half as much house, half as much useful property, as dollars formerly invested and hence I must have twice the rate of return even on these high investment costs in order to be as well fed as I was before the war.

Utilities in these days are pleading for values based on reproduction costs and are also showing the increased rates charged for borrowed money in an attempt to get higher "fair returns" than formerly and on higher values than the real investment. A recent New Jersey Supreme Court decision seems to be a defense of such pleading. But it is believed to be wrong.

In support of the pleading the following argument is made: If I own a water works property and wish to sell it and reinvest my money in another water works property just like the one I own, I must get the present-day cost of the new property out of the old one or I shall lose something. And when I reinvest this cost in the new property I must have the present day rate of return on it. This is not true. I have just the same value investment that I had before. Neither can it be said that I can sell my old works at new cost of reproduction price and invest the proceeds otherwise at high rates. Has it occurred to the persons offering this argument that there are no utility properties being sold at present day reproduction costs? In the face of a soon-to-be-falling market one would be foolish indeed

to pay present reproduction prices for utility properties. Men who make such investments are not foolish to this extent. Only necessary additions are being made to existing properties, and on the cost of these necessary additions the going rate of return should be realized. No permanent investment or investment in a permanent enterprise of long standing is worth on the market today a sum based on or approximating present day cost of reproduction unless its earnings have warranted such worth.

No owner of bonds, mortgages, or stock of utility enterprises, nor any depositor in a savings bank, finds any more dollars in his hand, due to a change in the value of the dollar, when selling his bonds or stock or receiving back his own from a mortgagor or savings bank than he put into those investments before the war except as he may have purchased at a discount. Utility securities do not reflect any such increase in value as the difference between pre-war and post-war prices. Quite the contrary is the more common experience, even in those cases where reasonable advances in rates have been made. In general it is true that bank stocks, insurance company stocks and other like stable securities of regulated enterprises show no advance commensurate with the change in the value of the dollar.

Neither will he who loans today on a mortgage, or buys bonds of a utility, receive less dollars than he now loans, when after some years his mortgage loan is paid and his bonds mature. The value of the dollar will have increased but the lender will receive just so many dollars as he loaned, no less and, barring the effect of discount, no more.

It is true that investments in utility properties are not exactly like loans on mortgages, but neither are they like investments made in unregulated, freely competitive, businesses, free to earn all that their managers can make them earn. Utility properties have both privileges and restrictions not enjoyed or suffered by unregulated, freely competitive properties, and if anything were needed to demonstrate the fact that the cost of reproduction new less depreciation is not the value of the public utility property, or indeed, any regulated property, the fact that the securities of these properties in nowise reflect the change in the value of the dollar ought to be sufficient.

Indeed, the securities of very few incorporated industries, regulated or unregulated, reflect the change in the value of the dollar. The stocks of a few industries that have been able to make large profits during the war period did advance in value, many of them even

much more than the change in the value of the dollar would indicate, but always because of a change in their earnings, never because of a change in the cost of reproducing the physical property that was the instrument with which the management conducted its enterprise. It ought to be clear that the value of a going property is not what it would cost to reproduce that property. Its value is what it can earn at fair charges capitalized at a determined going rate for money, providing its earnings are secure for the future.

It is clear that the court did not mean value when it said value in that old Smythe vs. Ames decision. It is clear from the interpretation given by later decisions that it did not mean the sum necessary to create the property new as of the date of valuation, less existing depreciation, because it has definitely excluded from allowable costs of reproduction the costs of certain items that would of necessity be a part of a new construction at the time of valuation, notably the removal and replacing of pavement over underground constructions in those places where no pavements existed at the time the underground construction was placed. Apparently what it did mean, if the later decisions are to be taken as interpretations, was the present day (present day meaning the date of valuation) cost of doing the things that were done to create the property but by present day methods and with presently existing facilities. Always it is cost not value that is found.

Even the item of "going value" is by some engineers being reduced to a quantity said to represent the cost of producing the business of the property, and this definition has been most often apparently in the minds of the courts when writing opinions, although the first decision that included the item did not suggest the idea of cost at all. Engineers not liking judgment guesses and trying always to reduce all procedure to definite formulas, have suggested various ways of finding "going value," and while the final deliverance of the court is still a judgment guess it is based upon engineer's testimony which is most often based on an estimate of the cost of developing the business. Again, it is cost of the property used in the service of the public that is assumed to be meant by that word "value" in the historic reference case. Present day costs, then, of doing the things that were done to create the property, both the cost of the physical plant used by the management in producing service, and the cost of developing the working organization, and, curiously enough, the cost of developing a properly remunerative business, *not the business enjoyed*

by the property at the time of valuation but the business that it ought to enjoy predetermined by the engineer before the court has acted, as a step precedent to his estimate of going value, are assumed to be equivalent to value. Very curious procedure, this.

With respect to the physical plant at least, the generally accepted method means, so far as differences between 1914 and 1920 are concerned, during which few years there was little change in method or facilities, original cost to date appreciated to allow for the cheapened dollar. And original cost to date is investment.

Now, while because of the scarcity of houses and machinery, as compared with the demand, a good many buildings and some machines are changing hands these days, on a basis of new prices, land has shown no such extreme advance, except land that has produced greater earnings than heretofore. And as has been noted already, utility properties are not changing hands on any basis at all and certainly will not change hands on a basis of new prices; nor will any new utility properties be built by private enterprise so long as the clouds of reproduction cost value and falling prices are darkening the view of the future. What must be spent on existing plants, will be spent if money can be found, but no more.

Does not it seem to be clear, therefore, that present day reproduction costs of old properties are not their values, nor even the proper basis for estimating fair return at present day high rates?

And even in normal times, if such there be, when market prices are rising and falling alternately, is it the custom of any business to vary its book investment, on which it figures return, from year to year up and down with the change in the prices of the building materials and labor used in the construction of the plant which it uses in its activities? Not so, nor should it be so. For practical purposes the investment in a business plant does not vary from year to year with variation in the cost of the items that are included in its construction, however much it may do so in theory. After some years of more or less steady change in value of real estate, that part of the property may be written up or down as the case may be, but the wearing items of machinery are carried at what they cost until they are worn out or disposed of in some other way. But earnings are made to vary so far as possible with the needs of the times.

So would it seem to be proper to do with utility properties. Regulations providing for fair return on the investment, as that is considered in purely private ventures, the rate varying with the needs of

the times, should never be deemed to result in the taking of private property without due process of law nor without just compensation.

If we would just be fair with ourselves, recognize investment rather than cost of reproduction, misnamed value, as the basis for earnings, make it possible for a utility company to earn such a return as will command capital, varying the rate of return with the necessity of the times; deal with the utility fairly, and require fair dealing from it, we would have less troublesome litigation, less occasion or desire on the part of the utility to use sharp practice to secure fair return for its service, better service and greater contentment and comfort for the public and its utility servants.

A short time ago, in a paper not yet published, an effort was made to develop a logical method for finding fair return rate. It was concluded that from once and a third to once and two-thirds the market rate for money used in the particular industry in question is the fair rate of return. This is based on the preliminary conclusion also developed in the discussion, that it is most advantageous from the public standpoint that from two-thirds to three-fourths of the money invested in a utility enterprise shall be borrowed. This proportion of borrowed money reduces the return on account of risk to a minimum. It is reasoned that net earnings of twice the fixed charges must be shown to induce capital to venture as loans on mortgage, that is, to buy bonds. If the reasoning is correct, there should be net returns of twice the market rate on from two-thirds to three-fourths of the investment. This means from once and one-third to once and one-half the market rate on the whole investment.

It is believed that if utilities are allowed such return rates on their investments, full operating costs, and depreciation allowances, based on investment, there will be little further litigation, the utilities will be satisfied, and the public should be satisfied because it will be paying no more than a fair return on the investment used in its service. There will be no more discussions of "going value" nor arguments as to what shall be included in cost of reproduction. Costly work for lawyers and engineering experts will be minimized. Peace will reign whether prices go up or down.

WATER RATES IN SMALL CITIES AND VILLAGES[1]

By John Wilson[2]

According to the latest information the author has at hand, there are 202 water works plants in the State of Minnesota, of which 195 are publically and 7 privately owned. In view of the foregoing, the Minnesota Section of the American Water Works Association will be interested in water rates which apply particularly to municipally owned plants.

A municipality when operating a water works system is engaging in a commercial enterprise, and to be successful, it must furnish adequate service at reasonable rates, which must be in proportion to the service rendered and without discrimination.

The service rendered by a water works plant is of two distinct types; first, it must be ready to furnish water in comparatively large quantities under high pressure for short periods of time for the purpose of extinguishing fires; and second, it must furnish ample quantities of suitable water for domestic purposes under moderate pressure at all times.

It is now generally conceded that all the expense incident to the former should be borne by the village or city at large. It is possibly unfortunate that the method of arriving at the compensation for fire service has generally taken the form of hydrant rental, as the number of fire hydrants has but a remote relation to the value or cost of the service. It has been estimated that 60 to 80 per cent of the cost of water works plants in cities under 5000 is incurred by providing reasonable fire protection.

Two years ago the author was called on to report on the matter of rates for the village of Crosby, Minnesota, which problem involved some unusual and interesting features. Crosby has a population of approximately 3500, and owes its existence largely to iron mining industries in the immediate vicinity. The water works plant was

[1] Read before the Minnesota Section, November 6, 1920. Discussion is invited and should be sent to the Editor.

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installed in 1911 by a private company and operated by it until two years ago, when the works were taken over by the village.

The franchise under which the company operated provided, in case the village wished to acquire title to the plant, that a board of appraisers should be appointed to determine the value and price to be paid. In accordance with this provision, C. T. Harding, of Virginia, was selected by the company, the author was appointed by the village and John W. Alvord, a past president of the American Water Works Association, was selected as the third member.

The value of the plant, as fixed by the board, was $75,680. The plant at that time consisted of 12 ground water wells 70 to 80 feet deep, electrically driven centrifugal pumps, a 100,000-gallon elevated tank, about 6 miles of distributing mains 4 to 10 inches in diameter, and 34 fire hydrants.

The conditions which led up to the village taking over the plant were largely due to the failing of private wells, due to mining operations, and many of the outlying districts were entirely deprived of water. The company in the meantime was naturally very reluctant to make extensions. Immediately upon taking over the plant the village spent over $56,000 in extending the distributing mains and also installed 35 additional fire hydrants.

The first step in determining what would be a fair schedule of rates was to estimate the proportion of the cost of the plant chargeable to fire protection. It was accordingly estimated that 51.6 per cent of the appraised value and 45.9 per cent of the cost of extensions might justly be charged to fire protection and the remainder charged to commercial service.

The village had 356 consumers and 155 householders who had asked for connections as soon as the extensions could be completed. The question naturally came up as to who should install the meters and lay the connection from the main to the curb box.

In connection with this, the author suggested that the village assume the cost of these two items, inasmuch as the number of consumers was small compared with the amount of distributing main; that many of the householders were men of limited means who would be tempted to carry water rather than connect with the mains were they required to bear all the expense; and, furthermore, one of the principal needs of the water department was paying consumers. It was also suggested that, in consideration of the village bearing this expense, all consumers should pay a service charge sufficient to cover the interest on the necessary investment and depreciation.

In support of these suggestions, he quoted the following authorities. In the case of Samuel M. Gillmore vs. Hackensack Water Company, the New Jersey Public Utility Commission ruled as follows:

> The Board concludes that the Hackensack Water Company should take upon itself the burden of maintaining all such connections as lie within the public streets up to and including the stop cock. The practice of the company, requiring the consumer to pay for the installation of service pipe within the public streets and the stop cock, is disapproved as an improper and unreasonable charge. (December 7, 1915.)

A similar ruling by the Wisconsin Railroad Commission was as follows:

> The question as to who should own meters appears to be settled. The only point to be decided here is whether or not services are a part of the facilities which the utility is expected to furnish. The logical conclusion seems to be that the utility should install and own services to the curb line. The utility, and not the consumer has the right to occupy the streets, and all pipes laid in the streets should be the property of the utility, and we believe should be put in by the utility. The business of the utility is to deliver its product to the premises of the consumer. If the utility should own the mains through which water is carried to various sections of the city, it seems equally true that it should own all parts of the distribution system as far as the consumer's premises. The service pipe from main to curb is as much a part of the utility's distribution system as is the main itself. Both parts of the equipment have the same purposes—the delivery of water to the consumer's premises.

The California Railway Commission has reached the same conclusion (2 Cal. R. C. R., 989), stating it as follows:

> That it is the duty of a water company to supply service connections up to the property line, and meters, where meters are used, without direct expense to the consumer, seems clear both on principle and on authority. Such requirement seems entirely reasonable. The service pipe up to the property line and the meters, where used, are as necessary in the performance of the water company's duty to the public as its reservoirs, wells or mains. The consumer has no right to dig up the streets to lay a service pipe. That right belongs to the water company alone. It seems unreasonable to ask that the consumer should pay for service pipes and meters which are a part of the water company's system, which the consumer has no legal right to install and which are under the complete control of the water company.

The service rates suggested, which would be a regular monthly charge, in addition to regular meter rates, were as follows:

METER	RATE	METER	RATE	METER	RATE
⅝-in.	$0.40	1¼-in.	$1.80	2½-in.	$6.00
¾-in.	0.75	1½-in.	2.50	3 -in.	8.00
1 -in.	1.25	2 -in.	4.00	4 -in.	12.00

One advantage of a service charge is that it tends to regulate the department's income and thus aid in meeting current expenses, while graduating the charge according to the size of meter and connection protects the department against consumers demanding much larger fixtures than necessary.

As closely as could be ascertained, the yearly consumption of water would be distributed as follows:

	cubic feet
Measured by ⅝-inch meters	1,440,000
Measured by larger meters	188,520
Passing meter without registry	50,000
Street sprinkling	290,000
Drinking fountains	180,000
Flushing sewers, etc	30,000
Flushing trenches	10,000
Testing meters	600
Use in extinguishing fires	32,400
Total	2,221,520

It is very clear that the first three items should be paid for by the water consumer; the last one charged to fire protection; and the remainder should be charged to the village at large.

Unfortunately no means had been provided at the plant to determine the amount of water pumped. It was therefore assumed that the above would constitute about 60 per cent of the water actually pumped and that 40 per cent would be unaccounted for.

The total annual expenses for everything connected with the department was about as follows:

Interest on bonds $130,000 at 6 per cent	$7,800.00
Interest on other indebtedness $15,000 at 6 per cent	900.00
Clerk's salary, charge to Water Department	960.00
Superintendent's salary	1,800.00
Labor	600.00
Office supplies, postage, etc	500.00
Fuel	30.00
Meter repairs	100.00

Maintenance, supplies and depreciation	1,500.00
Electric current	612.50
Insurance	30.00
Telephone	25.00
Total	$14,857.50

It will be remembered that the extensions made to the distributing system were made necessary because of private wells becoming exhausted due to mining operations. The total number of houses to be served by these extensions was 331, while the number who declared their intention of taking water was but 155.

It is at once apparent that a rate for water which would yield a fair return on an investment such as incurred by these extensions would be unreasonable, and at the same time it would not be just or fair to place this additional expense on such consumers as the village already had.

The village was under moral obligations, at least, to contribute something to the relief of parties who had been deprived of well water. They were also engaging in a commercial enterprise, and should expect, the same as in any other business, to do so for a time at a financial loss.

It was therefore estimated a reasonable deficit over a fair return on these extensions would be $1700 per year, which should be included in the proportion of the expense borne by the village at large.

From the foregoing data the rates which should be put into effect and the income to the water department would be as follows:

Hydrant rental, 79 hydrants at $75.00	$5,925.00
Deficiency on fair return on extension	1,700.00
Water used by village at 18 cents per 100 cubic feet	1,000.00
Total due from village	$8,625.00
Service charge.	
400— ¾-inch meters at 40 cents per month	$1,920.00
2—1¼-inch meters at $1.80 per month	43.20
1—1½-inch meter at 2.50 per month	30.00
1—2½-inch meter at 6.00 per month	72.00
1—3 -inch meter at 8.00 per month	96.00
Total from service charge	$2,161.20
1,628,520 cubic feet of water at 25 cents per 100 cubic feet	$ 4,071.30
Making a total income from private consumers of	$ 6,232.50
And a total income from all sources of	$14,857.50

In this way the village would pay 58 per cent of the total annual expense and the water consumers 42 per cent.

The Wisconsin Commission ruled, in the case of Ashland, Wisconsin, that the city should pay 54.5 per cent of all fixed charges; and in the case of Ripon, Wisconsin, that the city should pay 75 per cent of all fixed charges; in which case it would seem that the distribution at Crosby would not be unreasonable.

Such items as clerk's salary were all charged to domestic service, while the fire service was charged with its share of interest on bonds, maintenance of fire hydrants, etc.

The case of Crosby will illustrate fairly well some of the principles of arriving at proper rates in a given case. It is now in order to consider briefly the rates now in effect, throughout the state. The following figures are necessarily not exact, but they are taken from about 140 towns and are therefore reasonably representative.

Fifty-seven per cent of the water plants in the state receive nothing whatever from the municipality in the way of hydrant rental or payment for fire protection. Where hydrant rental is paid, it ranges all the way from $4 per year per hydrant to $140, the average being about $35.

Seventy-eight per cent of the towns pay nothing for water used for public purposes, such as street sprinkling, while of those who do pay, 69 per cent do so on a flat rate basis, without regard to the amount of water used.

In commercial service, about 44 per cent are on a strict meter basis, 36 per cent on a combined meter and flat rate basis, and 20 per cent are on a flat rate.

The rates in most cases are on a sliding scale, decreasing as the amount of water used increases. The most extreme case is a town of a little over 3000, where they have 21 different rates for water and 20 different rates of discount for payment of bills when they become due.

In most cases the revenue derived from commercial service is not sufficient to cover the department's needs, and certificates of indebtedness are issued. These certificates bear 6 per cent interest and in many cases can only be disposed of upon a discount of about 10 per cent. Paper of this kind is allowed to accumulate until a special levy in taxation is made or bonds issued for paying off the indebtedness. The whole procedure is an expensive and extravagant way of doing business. In consideration of the present state of the

money market, many towns would do well to revise their water rates and place their departments on a cash basis.

A full legal discussion relative to who should bear the cost of installing service mains and as to the ownership of such mains when installed would of itself necessitate a very long paper. The following discussion applies more particularly to villages and municipally owned plants.

As to whether the consumer or the municipality should bear the cost of installing the service mains, the Minnesota laws very clearly leave this to the discretion of the governing body, which may require the consumer to pay part or all of the expense, or, on the other hand, may install the service entirely free of charge as it may deem advisable.

The State Attorney General's office has handed down an opinion that it is customary in Minnesota to consider the serivce pipe from the main to the shut-off box a part of the main.

Section 1313 of the 1913 Statutes reads as follows:

> The village council of any village now or hereafter having a water works system shall have power to levy a special tax upon all property especially benefited thereby, in front of which any water main shall be laid.

Section 1314 reads:

> The same may be divided up into five annual installments and shall not exceed the sum of one dollar per lineal foot of pipe laid in front of each lot or parcel of land, against each tract of land, and the same shall be a lien upon such land from the time that the tax is levied by the village council as hereafter provided, provided, however, that no lot or parcel of land shall be subject to such tax after five annual assessments have been levied, except as hereinafter provided.

Section 1326, Supplement 1917, a very lengthy section, reads in part as follows:

> It shall be the duty of every owner or occupant of any abutting property platted into lots and blocks having dwelling house or business property situated thereon to install a toilet in said dwelling or business property, and make connection thereof with the water and sewer in the street or alley adjacent thereto, ...

The section then provides that in case of refusal, the village may install such connection and assess the entire cost to the property, and that the payment of such assessment may be made in three annual installments.

It is thus very evident from the statutes themselves that the main and the service main are considered as two distinct features of the system, the assessment for the first being limited and spread over a term of five years, while the assessment for the latter is limited only by the cost and must be paid in three years.

However, the Attorney-general's office may not be so far wrong after all, for when we come to the ownership of the service main, or vested title therein, it seems a settled question that the village or utility has title to both notwithstanding the fact that the consumer may have paid in full the cost of installing the service, and is in this way considered an essential part of the main.

John W. Alvord, in a paper read before the second annual convention of the New Jersey Utilities Association, cites the case of the Knoxville Water Company wherein in valuing the property for a rate case, the company presented to the court the claim that all services were the property of the company, whether provided at the company's expense or at the expense of the private consumer. On this point the Master's opinion was as follows:

> In the matter of services, there is much difficulty, not as to price, for the proof seems to be with complainant (water company). Defendant's plumber witnesses when under cross-examination rather confirm it. Defendant says, and proof shows, that consumers were made to pay for all but 423 of the 4,323 services stated. . . . . Complainant says it actually owned these connections, ... they are in the streets and cannot be changed by the consumer. In case of competition, this consumer would not be permitted to connect his with another main. . . . . The contention is that no matter how obtained, the property is theirs and the charge heretofore made was an additional charge for water at that time, etc.
>
> I see no way of resisting this conclusion, although I confess to much sympathy with defendant's contention that the citizens having paid for it should not be charged an interest on its value.
>
> The master then allowed the sum of $38,714.00 for the service pipes.
>
> The U. S. Supreme Court in passing upon this case examined the allowances of the master in detail, making no deductions from the master's findings on the value of services. The Supreme Court refers to the service pipes in the following language:
>
> "The first fact essential to the conclusions of the court below is the valuation of the property devoted to the public use, upon which the company is entitled to earn a return. That valuation ($608,000) must now be considered. It was made up by adding to the appraisement, in minute detail, all of the tangible property. the sum of $10,000 for organization, promoting, etc., and $60,000 for going concern. . . . . The cost of reproduction is not always a fair measure of the present value of a plant which has been in use for many years. The items composing the plant depreciate in value from year to year

in a varying degree. Some pieces of property, like real estate, for instance, depreciate not at all, and sometimes, on the other hand, appreciate in value. But the reservoirs, the mains, the *service pipes*, structures upon real estate, standpipes, pumps, boilers, meters, tools and appliances of every kind begin to depreciate with more or less rapidity from the moment of their first use."

It will thus be seen that the master included the service pipes in his valuation on the theory that title was in the company, although paid for by the consumer, without any allowance in the reproduction cost for the contribution, and that the United States Supreme Court, by inference at least, affirmed his report as to the service pipes being the property of the water company.

Mr. Alvord also referred to a case presented to the United States Supreme Court in the Washington Gas case (Washington Gas Company's, District of Columbia, 161 vs. 316, 326). Here the company wish to disclaim all title to the service pipe on the grounds that it had been paid for by the consumer, and thus avoid liability because of a defective service box. Mr. Justice White, speaking for the court, said:

The plain object contemplated by the formation of the gas company was the supplying of gas to be by it manufactured to consumers, and it is obvious that this could not be done without making a connection between the street mains and abutting dwellings. When such connections are made with the mains they receive from them and convey into dwellings highly inflammable material, which flows by an uninterrupted channel from the mains themselves. It must therefore necessarily have been contemplated that such connections with the mains as were from their very nature incidental to an inseparable connection with the consumption of gas should be a part of the apparatus of the gas company, and be under its control, rather than under that of the city or the property owner.

Indeed the control by the gas company of the connection from its mains to the point of use is as absolutely necessary to make it possible for the company to carry out the very purpose of its charter as are the retorts and mains.

Moreover, the provisions of the charter show that it was thereby contemplated that the connection between company's mains and the places where the gas was to be consumed should be made by the gas company, and become a part of its apparatus.

The charter does not confer the power upon those desiring a supply of gas, but gives such power to the company. . . . .

We conclude, therefore, that the duty was imposed upon the gas company to supervise and keep the gas box in repair. This duty not only did not conflict with the charter of the company, but, on the contrary, is sanctioned by its tenor and is imposed as an inevitable accessory of the powers which the charter confers.

Nor do we think that this duty was affected by the circumstances that the cost of the labor and materials used in the construction of the connection and gas box was paid by an occupant or owner of property, who desired to be fur-

nished with gas. As the service pipe and stop cock was a part of the apparatus of the company and was used for the purpose of its business, it is entirely immaterial who paid the cost or might in law on the cessation of the use of the service pipe and gas box by the company be regarded as the owner of the mere materials.

Certainly, it would not be claimed that if the box and its connection became so defective or out of repair that gas escaped therefrom and caused injury the company could legally assert that it was under no obligation to take care of the apparatus because of the circumstance that it had been compensated by others for its outlay in the construction of the receptacles from which the gas escaped.

The argument seeking to distinguish between the service pipe and other appliances of the gas company and the gas box so as to make the company liable for one end and not for the other is without merit. All these appliances were parts of the one structure put in position and used together for the purposes of the company.

The conclusions reached after investigating all available court decisions are that the consumer in paying all the costs incident to installing service mains does not acquire ownership, but is simply making a contribution, paying in advance for anticipated services or paying in part for the enhanced value of his property because of such installation.

By assuming the burden of installing service mains, the consumer supplies a portion of the necessary capital, and is entitled to consideration to that extent in the rates charged for water service.

The Minnesota law in leaving the question as to who shall furnish the capital for installing service mains, the consumer or the village, to the discretion of the governing body, seems entirely proper, for in this way the work can be financed by the party who can do so most advantageously.

THE STANDARDIZATION OF BRASS GOODS FOR WATER WORKS[1]

By Adolph Mueller[2]

In all merchandising and manufacturing a greater variety of articles is offered than is necessary or desirable. This is due entirely to the desire of the merchant or manufacturer to meet an individual as well as a general demand on the part of his trade. Speaking more specifically, the manufacturer produces goods after patterns which his customer suggests rather than produces goods according to his own patterns, which he knows will fulfill necessary requirements. There are many customers who have ideas and some have hobbies which they insist shall be followed. Frequently it is a hobby and nothing else, but it is not an easy matter to disabuse a man's mind of a hobby. In many instances the hobby is the result of stubborn insistence growing from the habitual use of a certain kind of goods, and an antagonism to changing to any other particular kind of goods. The use of a line of goods with some individualizing feature becomes a habit, and habits are hard to change. Some such lines are impractical from a manufacturing standpoint and they are not only more expensive to make but they add to the cost of the goods which are more nearly standard in character.

Much of the trouble which we face is due to the willing acquiescence of manufacturers through their desire to secure business. We are all guilty. We have taken these orders contrary to our own judgment. We find as a result that one town must have a particular kind of thread, another insists on a particular style of body and still another wants a particular kind of key, none of which is really essential to efficient duty, because none of these have any real bearing on the real purpose of the article. They are merely fads which we have tolerated until they have become obnoxious, principally because they are unnecessary. As manufacturers who

[1] Read before the Montreal Convention, June 24, 1920. Discussion is requested and should be sent to the Editor.

[2] H. Mueller Mfg. Co., Decatur, Ill.

are in daily contact with all these problems we believe the time has come to call a halt.

A committee on standardization of water works brass goods has been appointed by the National Association of Brass Manufacturers and we are here to ask the assistance and coöperation of this Association in doing this. We want you gentlemen to realize that a standardization in corporation and curb cocks will be as much to your interest as to ours. As manufacturers we might arbitrarily make any change or establish any standard upon which we might agree, and by holding to this agreement force the change upon the trade. That is not our desire, however, we want to make changes only where we have your support and we want to make only such changes as our experience as manufacturers teaches us will benefit the entire trade.

In a manufacturing sense every hobby or fad in goods, when acceded to, calls for, first, special patterns; second, a special factory run, frequently with special tools. It means special attention to the order until it is boxed and shipped. Special patterns, tools, etc., mean added factory equipment, which may be used but once or twice a year, this meaning an added investment which must be reckoned with in storage, insurance, etc. It does not go into a special overhead charge against these goods, but it goes into the factory's general overhead, so that ultimately users of regular goods must pay a certain proportion of the expense of the special goods.

Now this is not fair to the man who is content to use regular patterns, but the manufacturer, if he seeks to know and maintain a cost system, can't very well help himself.

Frankly we manufacturers want your business, we want it at a fair, legitimate profit. We want to give you the very best goods at the lowest reasonable price possible. Anything that we can do to reduce the cost of manufacture is more to your advantage than ours, for this reason, whatever the manufacturer's selling price is, the profit is still there, and must be if we expect to continue business. We also desire to emphasize the necessity of eliminating odds and ends or irregular styles of goods in order to be able to give better service in shipments. These are all simple facts but they are worth stating. It's overlooking simple, fundamental facts that gets us into all kinds of trouble.

The first step in the accomplishment of what we desire is an understanding of and an agreement to a standardization of corporation

cocks. You gentlemen doubtless realize that during the past few year there has been a marked trend toward standardization. This was emphasized by the war which presented to the American mind the fundamental fact that to accomplish our purpose we must as a people act in unison, that is, certain things had to be done in a certain way at a certain time. It did not make any difference whether fuses or shells were made in the Glauber, United Brass, Hayes, Smith or Mueller plant, they had to be made according to accepted and approved standards. The officials who bossed the job did not care a rap what they or we thought about it. The manufacturer was a mere detail, it was the ultimate use of the goods that governed the question. For instance the goods had to be so made that if it became necessary to use parts made by the different factories to secure a complete article, they would fit and function. There is good, hard common sense behind this plan. That is just what we want to apply in the case of corporation cocks. We do not see any reason for having more than three different kinds of threads to corporation cocks, or more than three styles of cocks.

To begin with, a corporation cock is not beautiful or artistic, it is strictly utilitarian. Its one purpose is to form the connection with the main. Its insertion in the main is accomplished through the use of a tapping machine or a monkey wrench or in fact any kind of wrench with which it can be securely gripped. For this purpose it should have flats on the side. So much for the mechanical necessities. As a service proposition it must have strength to withstand the strain of installation as well as the strain resulting from the depression of the earth.

There is one other point and that is the threads. As nearly as our committee can ascertain there are three threads which must be taken into account, namely, cocks to be inserted with a tapping machine, iron pipe threaded cocks, and a coarse thread on cocks for wood mains. These three cover practically every necessary phase of water works practice.

The iron pipe thread is standard. The wood pipe thread is made coarse like a wood screw because it screws into wood pipe and should be standardized. The cocks inserted with a machine should have a uniform thread adopted as standard. Experience has proved that any other thread is no better than the three mentioned, although there are innumerable threads which to the eye are identical with those which we desire to standardize. It is when you try to make

them mesh that you learn they are not the same. They are off a sixty-fourth part of an inch but that sixty-fourth is just enough to cause you worry and inconvenience. It's that sixty-fourth that represents the fad or hobby of someone who developed the belief that without it a corporation cock is imperfect. As a matter of fact, this variation has nothing whatever to do with the service qualities of a cock.

What you want a corporation cock to do is to screw into a main and make a water-tight joint; to have a good thread to which you can connect the goose necks; to have sufficient strength to withstand the strain of installation and the strain resulting from settling or depression. When you have this kind of a cock you have all that you can reasonably demand. When you can get it through the selection from the cocks adopted as standard you have gotten something through a process of elimination that will answer the same purpose in Massachusetts that it will in California.

These Eastern and Western extremities were purposely mentioned to show you what "specials" mean. In our experience, eighteen cities in Massachusetts demand 36 different kinds of corporation cocks, different in minor details only. Ten cities in California require 36 different kinds of cocks, making 72 different kinds in 28 cities.

Some of the facts regarding corporation cocks that we have gathered are interesting:

	NUMBER OF CITIES	NUMBER OF KINDS AND SIZES
Northeastern Division, New England, New York, New Jersey and Pennsylvania	63	156
Eastern Division, South Atlantic States	8	26
Central Division, the Mississippi Valley and some South and Southwestern States	40	91
Western Division, Rocky Mountain and Pacific Coast States	17	59
Total	128	332

It takes 332 styles and sizes of corporation cocks to meet the needs of 128 cities where three styles or patterns in sizes from 1½ to 2 inches, or 21 cocks would answer. It is doubtful if any of you gentlemen realize the extent of this wide demand and what it means to a manufacturer.

These are some of the suggestions that have been made regarding standardization of corporation cocks:

Make all corporation cocks with flat sides, eliminating all round bodies or other shapes.

Eliminate squares and hexagonals on all cocks except on $1\frac{1}{4}$-inch, $1\frac{1}{2}$-inch and 2-inch sizes.

Eliminate $\frac{3}{8}$-inch sizes.

Eliminate female thread corporation cocks.

Adopt the three kinds of thread already mentioned.

Reduce the openings on iron pipe threaded corporation cocks, in the smaller sizes, making $\frac{1}{2}$-inch cocks with $\frac{3}{8}$-inch opening, $\frac{5}{8}$-inch with $\frac{1}{2}$-inch opening, $\frac{3}{4}$-inch with $\frac{5}{8}$-inch opening and 1-inch with $\frac{7}{8}$-inch opening. The reason for reducing the opening in iron pipe threaded cocks is because it is more practical for manufacturing and allows more metal, making a stronger cock.

Cocks inserted with machines and wood main-cocks to have full bore or openings.

The couplings or outlet end of all corporation cocks to have standard iron pipe threads one size larger than body.

All couplings to be standard as to length and weight.

All lead flange work to be standardized threads for nut and spud and uniform length and weight of sleeves.

All these suggestions may not be adopted but they are being discussed. Why should cities with a population of from 10,000 to 30,000 require a special round body corporation cock with special inlet and outlet threads when New York, Chicago, Detroit, Omaha, Denver and Los Angeles can get by with regular patterns and regular threads. There is no reason at all except the smaller cities have been given what they have asked for. Any change which has been suggested entails no hardship or expense on cities which have special sizes and threads.

Any change that has been suggested does not in any way affect the service-giving qualities of the goods, nor does it affect their strength or wearing qualities. It simply makes a standard article and the nearer we can get to standards the better it will be for manufacturer and consumer alike.

As previously stated the National Association of Brass Manufacturers has appointed a committee on the standardization of water works brass goods and we would greatly appreciate having the American Water Works Association appoint a committee or in some manner advise, assist and coöperate with us in the work we are endeavoring to accomplish.

DISCUSSION

JOHN M. DIVEN: Some of the things about which the manufacturers of brass goods are now complaining would probably be found on investigation to have originated with them. The user of such goods is the person who discovers their defects and who is best able in many cases to suggest improvements which will make them more useful and serviceable. Of course, we can all appreciate what a burden a multiplicity of patterns is to the manufacturer; in a hydrant manufacturing plant there were seventy-odd patterns for nozzles, for example, which is manifestly an unnecessary number. Under the circumstances the best progress toward remedying this situation will lie in the joint action of both manufacturer and user of brass goods, and consequently the speaker moves that a committee of this Association be appointed to coöperate with the New England Water Works Association and the National Association of Brass Manufacturers in developing standards for brass goods for water works.

JOHN N. CHESTER: Mention has been made of changes in the rod and square on corporation cocks, and in standardizing such things it is very important to avoid adopting some details which will result in a laborer putting a 16-inch Stillson wrench on the top of his key and twisting the key so badly as to cause embarrassing leaks. The user should certainly be represented on any standardizing committee in order to present his views of what brass goods should be, and the speaker therefore seconds Secretary Diven's motion.

The motion was put and carried.

ADOLPH MUELLER: The manufacturers of brass goods do not all agree among themselves as to what changes are desirable. For example there is a difference of opinion regarding the elimination of the $\frac{5}{8}$-inch cock. Some manufacturers believe that it should be dropped, but the speaker holds that so long as water works operators insist on having it, the $\frac{5}{8}$-inch size should be retained. The final action taken should be one which will work the greatest service to maker and user. The fewer the sizes and types of these brass goods, the easier it will be for users to have their orders filled promptly, since a maker will be justified in producing standard goods for stock. The better the standard design of the goods, the quicker the passing away of the old patterns but rarely called for. Mr. Chester's state-

ment about the danger of putting a wrench on the side of a corporation cock brings up a case in point; will all users agree with him? There does not seem to be much danger of such trouble if the laborer is intelligent, but if the users of such cocks believe the danger is there, the makers of cocks will meet their wishes. What is desirable is agreement upon what is really best for the user, so that can be made in quantity with a reasonable certainty of its purchase throughout the country as the best.

AN IRON RANGE WATER SYSTEM: CHISHOLM[1]

By C. J. Sullivan[2]

In order to deal as concretely as possible with the problems to be solved in connection with the production and sale of pure water, it may be of value to indicate briefly some of the difficulties encountered in the development of the plant at Chisholm.

Chisholm is situated on the west shore of Longyear Lake and has a population of 9000 people. The water works are municipally owned and operated and are governed by a Board of Commissioners. When the author took charge of the water works and filtration plant as superintendent thirteen years ago, the condition of the plant was deplorable. The equipment consisted of a Worthington 600-gallon-per-minute fire pump, a wooden elevated tank with a capacity of 37,000 gallons, giving a maximum pressure of only 65 pounds at the pump station, the lowest elevation, a 1,000,000-gallon mechanical gravity filter of two concrete units, only one of which was equipped and in working condition at that time, and a 100-horse power, return tubular boiler that had not been cleaned since it was installed. The reason advanced for this last condition was that with only one boiler, the time limit on the filtered supply of 50,000 gallons was not sufficient to warrant a shut-down with the limited capacity of the wooden tank and the small suction well.

Permission was obtained from the electric light company to connect to one of the boilers of its plant located about 200 feet north of the village boiler room. By running a 4-inch pipe line from the header of the water works boiler to theirs, paying a flat rate for the steam, it was possible to shut down for three days and make a thorough cleaning. Before doing this, however, a 24-hour test run was made on coal consumption, which showed 3 tons used for the 24-hour period. After cleaning and making some changes to the

[1] Read at the Duluth meeting of the Minnesota Section, November 6, 1920. Discussions are invited and should be sent to the Editor.

[2] Superintendent Water Works, Chisholm, Minn.

open heater, a second similar test showed a coal consumption of slightly less than a ton for the 24-hour period. This effected a saving, based on the price of coal at that time, of over $4000 per year.

The raw water supplied to the filters was pumped from Longyear Lake, which was in a very bad state of pollution, as it received then and had been receiving for two years prior to that time, the raw sewage from the village. This was in the late fall of 1907, but with careful operation it was possible to get along with this supply until the following April, when a supply line for the filters was laid to the Monroe Mine.

This lake water was high in color and had an alkalinity of 17 parts per million. The author's predecessor was using 15 grains per gallon of aluminum sulphate. Immediately the aluminum sulphate was cut down to 1½ to 2 grains per gallon and milk of lime was added to the amount of 0.5 grain per gallon, and the results were very satisfactory. To make this change it was necessary to discharge two filter operators, political appointees, who were adverse to education. Experience in this connection emphasizes the desirability of licensing filter operators to insure the employment of competent men.

The present equipment consists of a 2,000,000-gallon filtration plant in four units, the old filter having been repaired and remodeled. The wooden solution tanks have been replaced with concrete, new chemical feeding orifice boxes installed, and two new electrically driven, submerged, sludge pumps set up for cleaning the sedimentation basins, which under the present conditions is done twice each year. Floats and gauges were installed where needed. A 300,000 gallon concrete clear well, a 300,000-gallon elevated steel tank giving a maximum pressure at the pump station of 95 pounds have been built, and also a 400,000-gallon concrete raw-water storage and sedimentation basin in duplicate, one equipped with baffles installed to determine what effect there would be on the time run on the filters by using the basins alternately. In cleaning the basins, it was found that the one equipped with baffles contained considerable iron sludge, while the other without the baffles was free from sludge, showing that the sludge was carried down from the basin and removed at the filter plant.

Duplicate feed lines from the raw water storage basins supply the filters, 7000 feet of 14-inch steel pipe connect the raw water storage basins with the discharge line of the deep mine pump at the surface

of A shaft, Monroe Mine. There is also an emergency 8-inch cast-iron pipe line to the same shaft.

All told there are 18½ miles of water mains, 9 miles of ¾-inch services, 110 fire hydrants, 347 gate valves and 1244 service taps. All water mains are laid on the north side of the street and every second avenue is gridironed. The mains are laid 18 feet from the property line and each block is controlled by a standard gate valve, installed in line with the intersection of the avenue. By this method a green man has no difficulty in shutting off the water because of his inability to find the valve. His instructions are to measure 18 feet from the property line on the street intersection in line with the avenue. Each hydrant is controlled by an independent valve. There is a record of every curb valve and no trouble is experienced in finding any one of the 1244 installed to date, should they become snowed under or covered over with dirt by the street gang.

No applications for water main extension are honored unless the applicant guarantees the department that a service connection will be made for each 100 feet of water main laid. A start was made a year ago to install meters, and within the next two or three years the system will be 100 per cent metered.

For the month of October, 1919, the water output was 24,267,000 gallons as against 20,263,000 gallons for October, 1920, or a saving of over 4,000,000 gallons of water per month made by replacing a badly leaking 8-inch main. The readings are taken daily from a Simplex valve meter installed in the office of the superintendent.

The water collected underground at A shaft, Monroe Mine, is the mine drainage, and when pumped to the village is often highly colored, very turbid, and contaminated with sewage organisms. After a period of sedimentation, it flows by gravity to the filters, where it is treated with aluminum sulphate as it enters the mixing chamber, the records showing an average of 0.67 grain per gallon applied for the month of October, 1920. It then passes through baffles to the sedimentation basins of the filters, having a flowage of six hours. The effluent from the filters is free from color, and a very high percentage of the bacteria is removed. From the clear well the effluent flows to a small concrete suction well, where the water as it enters the suction of the pumps is dosed with chlorine gas in the amount of 0.14 part per million. The chlorine gas apparatus was installed in 1915, and to the best of the author's knowledge was the first of its kind installed in Minnesota. Previous to

the installation of the apparatus, the effluent from the filters was treated with hypochlorite of lime by apparatus installed under the supervision of H. A. Whittaker, director of the Division of Sanitation, State Board of Health of Minnesota.

There are two chlorine gas machines, one in operation and the other held in readiness in case of trouble. To date but very little trouble has been experienced with this apparatus. At first several renewals of the control valve were necessary, but this was entirely the fault of the operators putting too much tension on the valve when closing.

Dependence is not placed so much on the parts per million of chlorine fed to the suction of the pump as on getting sterile plates. In the laboratory in connection with the plant, bacteriological examinations are made daily, unless very evidently unnecessary, and the aim is to get sterile plates at all times. Generally the plates are sterile, but at times a count of one or two colonies per cubic centimeter is found. The tests for B. coli on the water after chlorination are negative at all times. The laboratory with equipment was planned by the State Board of Health, and the author is indebted to Mr. H. A. Whittaker for his assistance and service in this connection.

While conditions are somewhat similar in all of the towns of the Iron Range, the variations are such as to require the most careful analysis of the situation in any locality in order to determine the best solution of the problems found in each case. This suggests the advisability of the attendance of all Range Superintendents at the meetings of the Minnesota Section, for their active participation would make available to all the experiences of each in the solution of his problem to furnish to his community an adequate supply of pure water with the greatest economy consistent with excellent service.

DAMAGE TO DEEP WELLS BY SEA WATER[1]

By W. P. Mason[2]

Those who are familiar with the geography of Long Island, N. Y., will recall that an "inside water-way" extends almost completely along the Southern coast so that a boat of reasonable draft could sail easterly from Great South Bay nearly the entire length of the South shore without being exposed to the surf, and then, by means of a short canal already built, could enter Peconic Bay and finish the trip to the end of the island. Were it not for the presence of a narrow neck of land immediately to the east of Jamaica Bay the start could be made from within the limits of the City of Brooklyn.

It has been proposed to cut through this said neck by means of a canal 100 feet wide and 12 feet deep, thus completing the waterway. The construction of such a canal, if built, would be undertaken by the Federal Government and the necessary land, together with the bridges over the canal, would be furnished by the State of New York.

Several routes for the proposed work were considered, which naturally presented varying costs and engineering difficulties, the former embracing damages to private properties. Among the properties for which damages might be claimed are the wells of the Queens County Water Company which are so situated as to be within comparatively short distances of two of the contemplated sites of the canal, and, as the channel would carry salt water, the question presented was would the admitted sea water damage the public water supply derived from the wells.

It was proposed that the canal should run for a considerable distance in a straight line through territory adjacent to the pumping plant of the Queens County Water Company and within 50 feet of the nearest well; or else that it should pass through a district further to the south where, by means of a wide bend, it would pass the nearest well of the Company at a distance of about 1000 feet, as shown in figure 1.

[1] Read before the Montreal Convention, June 24, 1920. Discussion is invited, and should be sent to the Editor.

[2] Professor of Chemistry, Rensselaer Polytechnic Institute, Troy, N. Y.

The soil of the District is practically a pure sand of about 0.23 effective size and 1.69 uniformity coefficient.[3] The top layer is tillable and adapted to the growing of crops, but the level corresponding with the bottom of the canal is simply sand.

The southern portion of Long Island, as is well known, consists of various strata of sands and gravels, more or less distinct, and, at differing depths, separated by discontinuous layers of clay. These strata are water-bearing and dip towards the south so that artesian developments are possible along the southern coast.

The source of this sub-surface water is the rain which falls upon the island itself, the precipitation being about 44 inches per year. Because of the sandy character of the soil the percentage of percola-

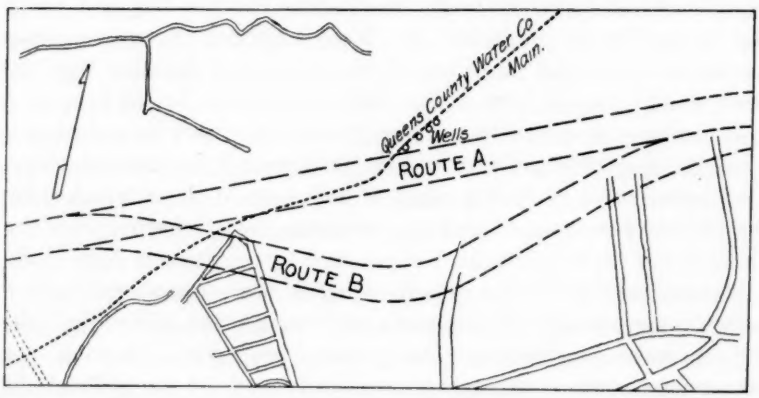


FIG. 1. RELATION OF ALTERNATIVE CANAL ROUTES TO WELLS OF QUEENS COUNTY WATER COMPANY

tion is very high, 42 per cent according to Burr, Hering and Freeman, and the amount of run-off correspondingly small, conditions which greatly aid the volume of underground flow.

The back-bone of the island not being of much height, the wells that have been sunk to the lower gravel layers flow at only moderate elevations above the ground surface and it is therefore common practice to secure their water by pumping.

The water-table, or surface of the underflow, slopes southward at about 10 feet per mile, as shown in figure 2, and the rate of water movement at a distance of about one mile from the sea may be

[3] See table by G. C. Whipple in Report on Additional Water Supply of New York by Burr, Hering and Freeman, page 580.

placed at approximately 30 feet per day or 2 miles per year.[4] This rate of movement is really quite variable. The results obtained experimentally by Prof. C. S. Slichter showed values of from 2 to 96 feet per day.[5]

The Queens County Water Company takes this underflow by a group of wells, 50 of which are 165 to 208 feet deep and 70 others with a depth of 30 to 45 feet. The deep wells pass through a layer of clay from 20 to 40 feet in thickness. The water is raised by pumps, aerated, filtered to remove the excess of iron and is then pumped to a standpipe, whence it flows to the consumers.

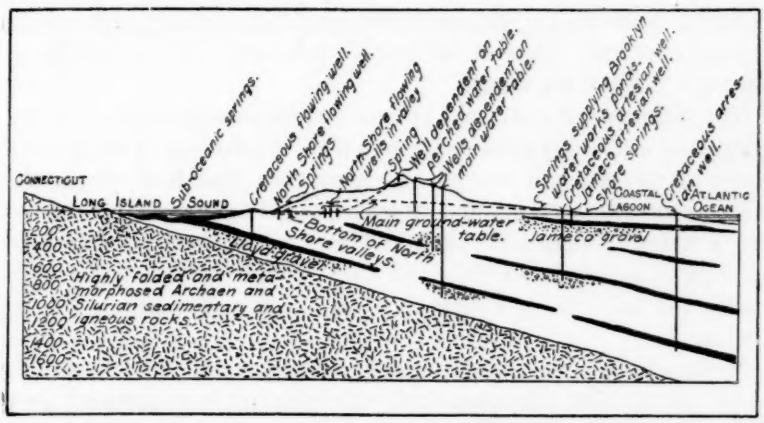


FIG. 2. DIAGRAMMATIC CROSS-SECTION OF LONG ISLAND, SHOWING CAUSE OF FLOWING WELLS

The quality of the water so delivered is excellent, as is shown by the analyses on file. In fact it may be considered a "normal" water, low in chlorine, hardness, alkalinity and total solids.

The action of driven wells such as used by the Water Company, when coupled up with powerful pumps, causes a material lowering of the ground water in the immediate vicinity of each well and the slope of its surface or "water table" becomes steeper as the well is approached, until it assumes the form of an inverted cone whose apex is at or near the bottom of the well. The slope of this conical depression in the water table, or the "cone of influence," as it is termed, becomes less steep as the distance from the well increases

[4] Reisert *vs.* New York City.

[5] Professional Paper 44, U. S. Geological Survey, page 104.

until it finally shades off to zero and merges into the general level of the ground water of the district.

The area that the "cone of influence" represents on the surface of the ground, that is, the area of its base, will depend upon the volume of pumpage compared with that of the underground flow and upon the frictional resistance presented by the material comprising the water-bearing stratum.

The drift of the ground water being towards the south and the Queens County wells being located north of both of the proposed canal sites, no natural flow of sea water towards the wells could be expected and the only explanation of its presence in the well water, should it make its appearance there, would of necessity point to an extension of the "cone of influence" sufficiently far to include at least one bank of the canal.

The tightness of the canal bottom might be suggested as a preventive of salt water passing through it to the damage of the ground water on the north, it being long known that "perched" ponds and streams are frequently found to leak but little; it must be remembered, however, that the canal would be of new construction, dredged through clean sand and therefore there would be but small opportunity for any silting action to close the porous material of its bottom.

Wells near the sea-shore are widely employed to furnish potable water but the first rule connected with their use is to carefully keep the volume of their delivery safely within the limit of their natural reinforcement. Both Liverpool, England, and Galveston, Texas, it will be remembered, pushed the pumpage on their wells beyond the margin of safety with the result that sea water was drawn into their systems in damaging quantities.

Does the southerly limit of the Queens County "cone of influence" reach 1000 feet from the wells; that is, does it extend far enough to include the more southerly of the two suggested sites for the canal?

This is a very important question and is bound up with the inquiry "Would the wells draw salt water in the event of the canal being built?" As lending light upon this matter it is wise to examine into the effect of heavy pumping upon the composition of the waters of sundry wells sunk in nearby parts of Long Island. The chemical data in the following tables are given in parts per million, and they, together with the pumpage, are the averages for the years in ques-

tion. The distances of the wells from the nearest tidal streams are given in feet.

The list of well waters here following could be materially extended but enough are given to illustrate general conditions. Many of the data here used have been derived from the records of the Water Department of New York City and from government publications.

Increase of chlorine in wells at Agawam. Depth of wells, 33 to 91 feet. Distance from tidal stream, 2000 feet

DATE	CHLORINE	HARDNESS	NITRATES	TOTAL SOLIDS	DAILY PUMPAGE
	p.p.m.	*p.p.m.*	*p.p.m.*	*p.p.m.*	*million gallons*
1898	5.7	7.2	0.04	33	0.3
1899	5.2	6.7	0.17	33	0.5
1900	5.1	8.0	0.19	34	1.3
1901	4.9	10.2	0.17	38	1.4
1902	4.3	10.2	0.06	30	0.6
1903	3.9	8.3	0.01	33	0.1
1904	4.2	7.9	0.00	27	0.2
1905	4.7	13.0	0.30	45	1.3
1906	4.8	9.0	0.41	47	1.8
1907	5.0	12.0	0.43	51	1.2
1908	4.6	8.0	0.18	40	1.1
1909	5.2	14.0	0.70	46	2.4
1910	9.5	18.0	0.63	59	2.8
1911	19.3	20.0	0.53	73	2.7
1912	9.1	22.0	0.45	68	3.3
1913	14.8	18.0	0.46	72	4.0
1914	32.7	25.0	0.49	110	4.1
1915	61.0	35.0	0.63	157	4.8
1916	62.2	33.0	0.65	158	4.6

This table shows by the increase of chlorine, hardness and total solids a draft of sea water due to increased pumpage.

Increase of chlorine in wells at New Brighton. Distance from tidal stream, 1200 feet

DATE	CHLORINE	HARDNESS	NITRATES	TOTAL SOLIDS	DAILY PUMPAGE
	p.p.m.	*p.p.m.*	*p.p.m.*	*p.p.m.*	*million gallons*
1903	107	166	2.50	382	
1904	104	191	3.35	421	
1905	160	228	2.84	526	
1906	115	190	3.14	436	
1907	244	271	3.44	761	
1908	225	281	5.12	718	
1909	372	376	2.51	1022	
1910	580	496	2.39	1436	3.3
1911	454	413	2.01	1215	3.4
1912	482	428	1.27	1298	3.6
1913	518	429	1.18	1347	3.4
1914	419	341	1.37	1090	3.4
1915	406	325	1.27	1028	2.5

The influence of the sea was manifest at the start but it increased by the operation of the pumps.

Increase in chlorine in wells at Shetucket. Depth of wells, 180 feet. Distance from tidal stream, 1500 feet

DATE	CHLORINE	HARDNESS	NITRATES	TOTAL SOLIDS	DAILY PUMPAGE
	p.p.m.	*p.p.m.*	*p.p.m.*	*p.p.m.*	*million gallons*
1897	4.3				0.0
1898	25.7	107	0.03	189	3.0
1899	185.0	164	0.00	534	1.7
1900	288.0	243	0.00	762	1.2
1901	388.6	324	0.00	987	1.4
1902	433.7	360	0.01	1096	1.0
1903	281.8	227	0.02	623	0.4
1904	280.6	249	0.03	728	0.5
1905	174.6	208	0.01	437	0.2

The wells pass through the clay stratum and the sea water probably enters from underneath that layer.

Increase in chlorine in wells at Woodhaven. Depth of wells, 80 to 150 feet. Distance from tidal stream, 2000 feet

DATE	CHLORINE	HARDNESS	NITRATES	TOTAL SOLIDS	DAILY PUMPAGE
	p.p.m.	*p.p.m.*	*p.p.m.*	*p.p.m.*	*million gallons*
1908	9.7	85	6.58	181	3.1
1909	11.3	88	7.13	177	3.1
1910	12.5	102	7.90	190	3.3
1911	15.8	106	6.90	206	3.3
1912	22.3	114	6.00	211	3.1
1913	52.3	159	6.25	306	3.5
1914	142.0	272	4.40	511	3.6
1915	223.0	290	3.44	647	3.4

Influence of the sea rapidly developed with small change in pumpage.

Increase in chlorine in wells at New Utrecht. Depth of wells, 30 feet. Distance from tidal stream, 5000 feet

DATE	CHLORINE	HARDNESS	NITRATES	TOTAL SOLIDS	DAILY PUMPAGE
	p.p.m.	*p.p.m.*	*p.p.m.*	*p.p.m.*	*million gallons*
1898	21.1	90	2.48	156	1.1
1899	21.2	88	3.24	144	1.1
1900	67.4	136	2.84	254	2.0
1901	123.0	186	2.88	398	1.8
1902	88.0	144	4.13	324	1.5
1903	76.4	136	3.12	273	1.4
1904	90.6	141	2.93	342	1.9
1905	102.8	164	3.17	354	1.9
1906	97.5	178	3.22	341	1.6
1907	106.6	170	3.17	362	1.6
1908	151.0	176	3.15	463	1.1
1909	163.4	207	3.36	521	1.1
1910	239.4	265	2.00	675	0.2

Influence of salt water was shown at the start and rapidly increased.

Increase in chlorine in mixed filtered water supplied by Queens County Water Company

DATE	CHLORINE	HARDNESS	NITRATES	TOTAL SOLIDS
	p.p.m.	*p.p.m.*	*p.p.m.*	*p.p.m.*
1899	3.7	12	0.00	33
1900	3.4	16	0.00	38
1901	3.2	15	0.00	41
1902	3.4	13	0.00	44
1903	3.6	12	0.02	42
1904	4.1	20	0.02	47
1905	4.1	13	0.01	43
1906	4.4	11	0.06	46
1907	3.9	12	0.07	53
1908	4.2	14	0.05	50
1909	4.9	16	0.17	55
1910	4.6	15	0.08	52
1911	4.9	17	0.12	57
1912	4.4	16	0.09	50
1913	3.9	13	0.07	49
1914	4.8	15	0.05	59
1915	4.8	18	0.10	54

Increase in chlorine in wells of Queens County Water Company. Unfiltered water. A mixture from both deep (165 to 208 feet) and shallow (30 to 45 feet) wells. Distance from tidal stream, 2500 feet

DATE	CHLORINE	HARDNESS	NITRATES	TOTAL SOLIDS	DAILY PUMPAGE
	p.p.m.	*p.p.m.*	*p.p.m.*	*p.p.m.*	*million gallons*
1899	3.7	17	0.02	37	
1900	3.2	13	0.01	44	
1901	3.2	16	0.01	50	
1902	3.4	16	0.01	48	
1903	4.2	12	0.07	45	
1904	4.2	23	0.05	52	0.3
1905	4.4	13	0.03	49	3.1
1906	4.3	11	0.10	49	3.6
1907	4.0	13	0.13	53	3.2
1908	4.2	15	0.13	59	3.1
1909	5.1	17	0.19	62	3.9
1910	4.6	16	0.17	58	7.1
1911	4.9	17	0.16	61	5.8
1912	4.3	15	0.12	54	4.3
1913	3.9	14	0.09	54	3.9
1914	4.2	16	0.12	54	3.4
1915	5.0	16	0.13	58	2.4

No material change in composition of the water.

Increase in chlorine in wells at Jameco. Depth of wells, 160 feet. Distance from tidal stream, 2000 feet

DATE	CHLORINE	HARDNESS	NITRATES	TOTAL SOLIDS	DAILY PUMPAGE
	p.p.m.	*p.p.m.*	*p.p.m.*	*p.p.m.*	*million gallons*
1898	5.5	78	0.01	117	5.2
1899	5.0	82	0.00	121	4.9
1900	4.7	90	0.01	123	4.9
1901	4.5	98	0.00	120	5.2
1902	4.5	92	0.01	126	3.7
1903	5.2	93	0.01	122	3.9
1904	4.3	87	0.03	125	3.8
1905	4.3	87	0.00	123	3.3
1906	4.8	71	0.04	116	5.1
1907	4.8	75	0.07	115	7.7
1908	5.5	69	0.05	123	7.8
1909	5.0	72	0.01	118	6.7
1910	4.5	82	0.04	127	9.1
1911	4.4	89	0.04	131	7.8
1912	4.8	92	0.10	134	8.6
1913	6.8	76	0.07	127	8.1
1914	13.9	79	0.06	138	8.1
1915	17.1	70	0.07	137	7.2

Influence of the sea very slow in developing.

Increase in chlorine in wells at Grant City, Staten Island. Distance from tidal stream, 3000 feet

DATE	CHLORINE	HARDNESS	NITRATES	TOTAL SOLIDS	DAILY PUMPAGE
	p.p.m.	*p.p.m.*	*p.p.m.*	*p.p.m.*	*million gallons*
1905	7.7	138	3.21	166	
1906	9.0	135	2.64	172	
1907	20.9	158	2.67	219	
1908	15.5	127	1.71	201	
1909	54.5	160	1.52	262	
1910	139.9	246	1.48	466	1.7
1911	119.9	216	1.31	433	1.7
1912	116.3	206	1.03	426	1.9
1913	150.0	228	1.18	504	2.0
1914	162.0	243	1.16	523	1.9
1915	348.0	404	1.27	946	4.6

The 1915 pumpage includes that of the driven wells on Southfield Boulevard. Although the rate has been fairly constant (omitting that of 1915) sea water has been drawn into the wells, and as a result the chlorine shows very high. The water was served to the people without dilution, as no surface or other water was available to mix with it. It is interesting to note that when the Catskill water was turned on the people complained of its taste, having been used to hard water in the past. Very recently, because of a threatened shortage of the Catskill supply, the former well water was once more put in use; again there was complaint because of the taste.

Increase in chlorine in wells at Gravesend. Depth of wells, 50 feet

DATE	CHLORINE	HARDNESS	NITRATES	TOTAL SOLIDS	DAILY PUMPAGE
	p.p.m.	*p.p.m.*	*p.p.m.*	*p.p.m.*	*million gallons*
1898	12.8	91	3.44	151	2.5
1899	12.7	92	3.68	150	2.4
1900	13.3	101	3.98	158	2.9
1901	13.5	88	4.63	152	3.0
1902	13.4	94	4.50	156	2.9
1903	14.5	99	4.00	168	2.8
1904	14.0	97	3.58	169	2.9
1905	14.9	91	3.99	177	3.0
1906	16.6	100	3.90	173	2.9
1907	17.6	99	4.24	182	3.2
1908	15.8	101	3.73	192	3.2
1909	24.4	107	4.32	192	4.4
1910	42.0	133	5.05	241.	5.4
1911	77.9	170	3.65	343	5.0
1912	99.9	201	3.30	366	4.7
1913	97.4	201	3.00	389	4.2
1914	213.3	343	2.86	662	4.8
1915	171.3	285	2.90	665	3.3

The influence of the sea was not so quickly felt doubtless because of the considerable distance to salt water but it nevertheless was manifest after a time. High as the chlorine finally became, those people who lived in the vicinity of the plant received it without dilution.

Leaving for a moment the ordinary form of well, it will be of interest to extend the inquiry to include the infiltration gallery situated at Wantagh. This gallery consists of a line of 20-inch and 36-inch pipe laid with open joints and from it the water collected is pumped to the consumers. Test wells were sunk at varying distances in a line at right angles to the gallery so that the effect of

pumping upon the height of the ground water might be observed. The effect of the gallery in lowering the ground-water level was felt at a distance of about 2900 feet.

As a further demonstration of the tendency of the gallery to lower the underground water level of the neighborhood, the records show that Jackson Jones pond, which is situated at a distance of 1500 feet to the south, was drained practically dry during the pumping period but, as the author personally observed, it has filled again since the pumps were stopped. It is important to note that this pond is an old one with a heavily silted bottom, consequently much more "water-tight" than a new canal dug in the sand would be.

To return to the well data already given, it will be observed that the Queens County Water Company wells have not materially changed in the character of the water delivered by them during the entire length of their service and it will also be noted that the quality of the water is excellent.

The water of the Agawam wells shows by its increase of chlorine, hardness and total solids that a draft of sea water has followed an increase of pumpage. The actual amount of the inflow of salt water is small compared with the record of other wells but the relation to an enlarged volume of pumpage is noteworthy.

Several points of interest are apparent when the tables are carefully inspected. Thus a pronounced "lag" is observed between some pumping records and the chemical changes in the water that the pumping is supposed to have produced. Again it is seen that a low pumpage may be productive of a great chemical change, as at New Utrecht, while a high pumpage may require a long period to establish material alteration in the amount of salines present in the water, as at Jameco.

At Shetucket, figure 3, it would appear that after heavy pumping had inaugurated an inflow of sea water, the quantity of such flow steadily and largely increased even after the volume of pumpage was progressively diminished.

So it would seem to be a fact that small information can be secured by attempting to closely correlate the pumpage with the analytical curves, and we are obliged to rest satisfied with the observation that only the general records for a period of years are important and their tendency is to show that pumping many of these Long Island wells is sooner or later followed by an infiltration of sea water, as indicated by increase of the salines.

How far the area of influence of the Queens County Water Company's wells extends towards the south it would be only guesswork to say, but from what we have learned by a study of other nearby wells the author would put 1000 feet as well within the probable limit and that is the distance from the Queens County pumping plant to the site of route B proposed for the canal. Site A is very much nearer, being only 50 feet from the wells.

In view of sand being such an admirable medium for filtration purposes, it was suggested that so long a distance as "1000 feet would be ample to provide for the removal of polluting material;"

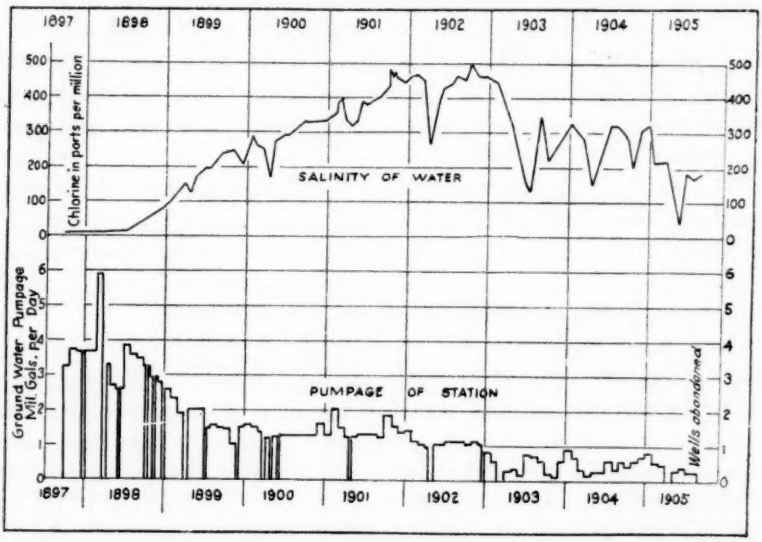


FIG. 3. SALINITY OF GROUND WATER PUMPED AT SHETUCKET DRIVEN WELL STATION

but the great difference must be borne in mind between sea water and organic pollution. The salines present in the former are in solution and are not decomposable by such processes as oxidation and nitrification. Common salt, the large item in sea water, will undergo any amount of sand filtering without practical change in quantity.

Fresh water is often to be found in the sands of the seashore and leads to the impression among some people that its source is the sea, the salt having been removed by a process of sand filtration; whereas the fact is that such water is from the land and is caught

on its way to the ocean. An interesting case may be observed at Heligoland, where, on a little islet near the main island, a well furnishes drinking water for the small population although the well is sunk only a few feet into the sand of an area two or three hundred feet wide and as many yards long. The reason for the fresh water being there is because its relative lightness allows of its floating for a time on the heavier sea water saturating the sand bar and rainfall is sufficiently frequent to replenish it before diffusion carries it into the body of the salt water below.

Common salt is represented in water analysis by chlorine and is one of the measures indicating sewage pollution. When it is known to be derived from sea water it is looked upon with less suspicion and the question then resolves itself into how high may the chlorine run without objection? Such a question is difficult to answer, because, under the circumstances, the chlorine is not an indicator of the presence of another agent far more dangerous than itself but is to be judged entirely upon its own merits or demerits, associated of course with the other mineral constituents of sea water. Taste is somewhat of a guide, although a rough one. Some people are capable of detecting the presence of ocean water when mixed with fresh in an amount equivalent to 100 parts of chlorine per million. This is not due to the taste of the common salt alone but to the combined effect of it and the other associated mineral salts. About ten times that quantity of sodium chloride in distilled water would be required to produce taste.

Standards whereby to classify waters are usually rather risky propositions to advance, but for tentative purposes the suggestion may be admissible to place 50 parts per million of chlorine, derived from sea water, as a suitable upper limit and twice that quantity as the amount not to be passed.

Hardness as well as chlorides will increase with admission of sea water, so that complaint against the water is more likely to originate among industrial users than from the sanitary side.

Under the supposition that the route B was chosen and the canal was constructed on that site, which is 1000 feet to the south of the Queens County Wells, the question might be asked, "How long before ocean water would begin to be noticeable in the water of the wells and how long before it would reach an amount sufficiently high to cause objection, of course assuming the pumpage to be fairly constant and at its present volume?"

Having in mind the tentative chlorine number mentioned above and referring to the tables already given we find that sea water represented by chlorine of about 50 parts per million manifested itself after the following periods, dating from the time of starting the pumps.

PLACE	PERIOD	DISTANCE TO SEA WATER	REMARKS
	years	*feet*	
Agawam	16	2000	Pumpage increased
Grant City	4	3000	
Shetucket	2	1500	
Gravesend	12		
New Utrecht	2	5000	
Jameco	17	2000	Chlorine still under 20
Woodhaven	5	2000	

Availing ourselves of the data given, it would seem a safe statement to make that a period of some years would elapse before sea water could reach the Queens County Water Company wells if the canal were constructed along route B, but it would be unsafe to venture an explicit prediction of the exact length of time "some years" might mean. It seems most likely that the influence of the canal water would be felt first, if not exclusively, by the shallow wells, for the reason that the deep ones pass through a layer of more or less protective clay; nevertheless we do not accurately know where the breaks, if any, in the continuity of the clay may be.

Sooner or later salt water would reach at least a portion of the wells of the Queens County Water Company if the canal were built on route B. Should it be dredged along route A, namely, within 50 feet of the Queens County Water Company plant, the adverse effect upon the water of the wells would be immediate.

Examination of the data here given points to the discouraging conclusion that if wells be once contaminated by sea water through overpumping, the damage cannot be readily repaired by stopping the pumps but is likely to be permanent. Several of the tables of results show that to be a fact, especially the one dealing with the plant at Shetucket.

This is graphically shown in figure 3 by W. E. Spear,[6] the salinity curve starting near the zero line under a pumpage of about 6,000,000

[6] Long Island Sources of Water Supply, volume 1, page 146.

gallons per day and persistently rising during the following years until it touched 500 parts per million although the pumpage during the period was rapidly lessened to about one-sixth of its original volume.

As to the spacing of wells so as to collect the maximum amount of the southward flow of the ground water of Long Island and at the same time avoid damage of drawing sea water into the system, the author cannot do better than quote[7] Mr. Spear's words:

> It appears preferable, under conditions that exist in southern Long Island, to intercept the ground-water by means of a continuous line of wells at frequent intervals along the proposed aqueduct line, rather than by groups of wells at stations one to two miles apart.
>
> In order that no water may escape to the sea between the groups of wells, the ground-water surface and the deep pressure gradient must, at every point on the line of the collecting works, be inflected away from the ocean towards the wells. The greater lowering of the ground-water near the groups of wells to effect this result is evident. Aside from the danger of drawing in salt water in pumping deeply at each group of wells, the greater efficiency of the pumps at the central stations is likely to be more than offset by the greater lift required by the greater depression of the water-table that is necessary at the central pumping-station.

DISCUSSION

WILLIAM GORE: The speaker would refer to the case of injury some twenty-five years ago to a deep well by sea water at Eastbourne. This well was sunk into the chalk (an amorphous kind of limestone) some distance back from the cliffs at the edge of the sea on the south coast of England. The well was the property of the water company supplying water to Eastbourne and had for many years yielded a water of excellent quality practically free from salt, when suddenly it became highly charged with salt, due to the access of sea water.

In the course of twelve months the salt reached to some two thousand parts per million. The company attempted to cut off the salt by closing an adit from which the salt appeared to have come, but without much success, and as the town was largely dependent on this well, salt water was continued to be supplied.

As the town of Eastbourne is a seaside summer resort, the condition of the water drove visitors away and caused a considerable loss to the citizens. For this reason, as there did not appear to be

[7] Long Island Sources of Water Supply, volume 1, page 186.

any sufficient action on the part of the company to seek new sources the municipal corporation proceeded to parliament to get a new water supply independent of the company and to sequester the company's distribution works. This proposal was, however, defeated, probably due to the promise of the company that it would proceed at once with new works at a greater distance from the sea so that the salt water well would be abandoned at an early date.

The sudden entrance of sea water after many years yielding of pure water caused some discussion. It was thought that when a well became salt by drawing in sea water the rise in the salt would be fairly gradual, dependent, of course, upon rainfall and pumping. A theory put forward which appears to have a high degree of probability was that the chalk contained quantities of natural zeolites which absorbed the salt until saturated, and while the well had actually been drawing sea water for years, this sea water had been purified by the natural zeolites in the same way as zeolites used in water-softening processes are regenerated by the application of a salt solution.

H. F. DUNHAM: One condition or feature has not been closely touched upon or set out. The Long Island and adjacent Atlantic shores are far from abrupt and in most localities quite flat and in some cases there are ridges of sand above ordinary high tide or high water while back of those elevations or ridges there are quite large areas that are but little above mean high water. Now when an exceptionally heavy storm occurs, the low areas are flooded with salt water, which may be confined or landlocked there for some time because of the wave action in washing up new ridges or adding to low places in old ones. In this way salt water may be held in the vicinity of wells that are comparatively quite distant from the shore, and unless there is an impervious bed of clay or other layer the effect of the salt water invasion will be noticed.

The Grant City wells referred to were installed under the direction of the speaker about half a mile from the shore line, but nearer shore a test or sample well was sunk to the same depth as the others and used to show the increase of chlorine due to any exceptional behavior of the Atlantic or to a heavy draft upon the wells in dry seasons. The Crystal Water Company had at that time two sources of supply, one on much higher ground, and one of them could be favored a little for a time at the expense of the other.

The Massachusetts Board of Health has shown, the speaker believes, that all ground water near the ocean carries an extra incre-

ment of chlorine. There are interesting figures in the reports of that board from the Swampscott Water Supply. The monthly examinations were compared and a danger or salt line suggested if not established.

Doubtless it would be impossible to find an entire absence of chlorine in a well that had been invaded by salt water but the speaker believes a heavy annual rainfall would do much toward restoring conditions after heavy storms or unusual draft upon the ground water and also that a number of "wet" years after dry years would help restore or improve the average quality of the supply.

So far as taste of water is concerned, it might be mentioned that years ago a water works superintendent in an Illinois city drank at the town pump and said the water made him ill for three days. Analysis of the water by a member of this Association showed chlorine about 1800 parts per million. Phone message to State Board of Health. Well filled up after finding that the "strainer" was about 6 feet below and but a few feet away from a newly made brick sewer. But the people who had been using that sickening well-water not only protested but were decidedly angry for weeks because their "right to use that sweet water had been interfered with." This Association has derived some advantage from its devotion to standards, no doubt, and it has also suffered and continues to suffer from that same devotion. But when it comes to establishing standards for taste it might be well to first specify a standard stomach.

LEONARD METCALF: It seems that a few words of caution, in which the author will probably agree, are desirable in connection with any standard chlorine content of water. The author's problem was a water supply for persons accustomed to water without taste. The speaker knows, however, of several cases where the practical limit of salinity, to which water could approach without causing complaints, was between 300 and 400 parts per million. When that limit was exceeded, the saline water had to be diluted in order to keep the supply acceptable.

There are cases of recovery in the quality of water from wells. The speaker knows of some cases where the salinity of well water increased from a very low figure to several hundred parts and, eventually, to 900 parts per million. For example, the limit of permissible salinity at Tampa is about 350 parts, but during times of heavy demand it is practicable to make use of water containing

considerably more salt by diluting it with less saline water until the average salinity of the mixed supply is below the maximum limit. It has been found there that if a well yielding very saline water is kept out of commission for a year or two, the salinity, decreased. The salinity does not disappear, because recovery is a very slow action and its rate depends to some extent on the quantity of water available.

RUDOLPH HERING: A year ago last winter salinity caused serious trouble in the water supply of Miami, Fla. Most of the supply comes from deep wells, but sometimes part of the supply is taken from shallow wells with the water level 25 to 30 feet below the surface. As the city was growing rapidly and there were not enough wells to meet the maximum draft without pulling on them heavily, salt water was drawn into the wells in such quantities that the supply became undrinkable and was used only for washing, flushing and like purposes. The cone of depression due to the heavy pumping extended beyond the shore line.

One main reason for the heavy draft was the heavy leakage from a large street main. During the summer this main was repaired, which reduced the pumpage greatly, and last winter the water drawn from the same wells was free from a saline taste.

CHESTER R. MCFARLAND: In regard to previous remarks about conditions at Tampa, it must be acknowledged that the Tampa Water Works Company has had a variety of experiences with salinity of water. The company had one well which was in use for 15 years, sometimes flowing under a natural head of 12 to 15 feet above sea level and sometimes pumped by compresed air. The salinity of the water from this well has varied greatly. At the beginning of operations it was around 21 parts per million. It has risen as high as 600 parts and then dropped to less than 100 parts, so that there has been no regularity in the curve of salinity.

Furthermore, salinity in the ground water is not at all uniform in the district where this well is located. One well may furnish water of very low salinity and another well sunk within, say, 700 feet, may furnish water with 2000 parts of salinity. One well may supply good drinking water and another close by, sunk to the same depth, may supply brine. In some cases resting will decrease the salinity, but not always. One of the interesting features of the salinity of the water in these wells is that the proportions of different salts is not the same as that of the salts in sea water.

STATISTICS OF THE WATER SUPPLIES OF THE PROVINCE OF QUEBEC[1]

By Theo. J. Lafrenière[2]

The Province of Quebec has a population distributed as follows: 18 cities with 1,101,200, 81 towns with 178,400, 220 villages with 158,400, 887 rural municipalities with 942,000, making a total of 2,380,000. The population of the cities and towns is then 53.7 per cent of the total population, leaving 46.3 per cent as rural population.

There are 440 water supplies in the province, but half of them are small, serving only a few houses in some cases. According to the data available, 59 per cent of the population of the province is served by water-works, and 41 per cent use shallow or tubular wells.

A special study of the water supplies of cities, towns and villages with a population of over 500 inhabitants shows that there are 230 such municipalities, and 192 of them, with a combined population of 1,383,700, have water-works. It is interesting to note from table 1 how the various sources of supply have been utilized.

Of the total population served by water-works, 86 per cent is supplied with river water, a very high percentage. This is due to the fact that, with four exceptions, all the cities use river water. When the water-works were installed, some forty years ago, the rivers were fairly clean and the necessity of pure water was not as well understood as it is today. The towns were built on the shores of large rivers offering a water supply of good appearance, and consequently the rivers were used in preference to more distant sources of supply.

The lakes, on the other hand, have not been fully utilized, when it is considered that only 3.8 per cent of the population is supplied from such a source. The numerous lakes all over the province offer a first class supply; but unfortunately, these lakes are not near the large centers of population. Twenty water-works use lake water, but they serve mostly small towns.

[1] Read before the Montreal Convention, June 22, 1920. Discussion is invited and should be sent to the Editor.

[2] Sanitary Engineer, Provincial Board of Health, Montreal, P. Q., Canada.

The water-bearing formations in the province are not well known; the available information on the subject is very meagre. Hence, only 10 per cent of the population is supplied with underground water. With few exceptions, the 75 water-works in this class use springs originating at the outcrop of a porous stratum underlaid by an impervious one. Such supplies are usually possible for small towns only. Several artesians wells have been sunk in the last few years, with remarkable success; the disadvantage of such a source of supply is that unless an extensive water-bearing formation is reached, the yield of the wells is uncertain and variable.

A great number of municipalities do not own their water supply, but with the exception of a part of the city of Montreal and two adjoining cities, this occurs in small towns and villages only. One municipality out of three does not own its water supply. The cost of water-works is high, and after their construction, the small town finds that most of its borrowing power has been used by the water-works and that practically nothing is left for other improvements. Consequently, in order to have both, the water-works and the necessary funds for other improvements, the municipality grants a franchise for the water-works, which is a revenue-producing utility. This practice is not to be encouraged, as in most cases the system does not provide for adequate fire protection, and eventually the municipality has to buy the system and practically build it new.

Since the creation of a provincial department of municipal affairs, the limit on borrowing power has been removed, but the necessary majority to sanction a by-law has been increased. Hence, it is hoped that the number of municipal water-works will increase.

If we examine the use made of the various sources of supplies by the municipal or private corporations, we find that in both cases, over 85 per cent of the population is supplied with river water. Only two private water-works use lake waters, while 40 small supplies are derived from springs and wells.

We have seen that 86 per cent of the population served by water-works is supplied with river water, which is usually unsafe for domestic use. However, all of this water is not consumed without previous treatment. In the province today, 858,000 people are supplied with filtered river water, and 170,000 with chlorinated water, giving a total 1,028,000 people using treated water. This number represents 86 per cent of the population using river water. Six municipalities, with a population of 60,000 people, now chlori-

nating their supply, have been ordered by the Superior Board of Health to install purification works.

Lake water and underground water being naturally good, it would seem that our water question is practically solved; unhappily, it is not so. The great percentage of the population is protected against water-borne diseases, but the remaining 14 per cent is divided among many small municipalities which will be harder to reach than the larger towns.

TABLE 1

Statistics of the water supplies in the Province of Quebec in towns of more than 500 inhabitants

	RIVER WATER	LAKE WATER	SPRINGS, WELLS	TOTAL
Municipal works				
Number of works	71	18	35	124
Percentage of number	57.3	14.5	28.2	100
Population served	903,778	49,929	92,523	1,046,260
Percentage of population	86.4	4.8	8.8	100
Private works				
Number of works	26	2	40	68
Percentage of number	38.2	3.0	58.8	100
Population served	288,734	2,950	45,745	337,469
Percentage of population	85.5	0.9	13.6	100
All works				
Number of works	97	20	75	192
Percentage of number	50.5	10.4	39.1	100
Population served	1,192,512	52,879	138,338	1,383,729
Percentage of population	86.2	3.8	10	100
Filtration practiced				
Number of places	29			
Population served	860,000			
Chlorination practiced				
Number of places	15			
Population served	170,000			
No treatment				
Number of places	53			
Population served	163,000			

It appears from table 1 that 53 towns, with a combined population of 163,000 inhabitants, use river water without any previous treatment. The streams from which these supplies are derived are more or less contaminated. Moreover, approximately 20 per cent of the towns supplied by underground water have a supplementary water intake in a nearby stream, for fire purposes.

Now the Quebec Public Health Act of 1915 gives to the Superior Board of Health extensive powers concerning the control of water supplies. Plans for all new water-works must be approved by the Board before the works can be installed. Furthermore, the Board has the right to make investigations and to order purification works where needed, or to order the causes of pollution to be removed. When the supply is owned by a private corporation the Quebec Public Utilities Commission decides whether the cost of the improvements shall be paid by the private corporation or the municipality, and in what proportion. To comply with the orders of the Board, the municipal corporation is allowed to borrow the necessary amount without being obliged to submit the by-law to its ratepayers, and the Board has the right to have the improvements done at the expense of the municipality, when the latter refuses to submit to the order.

But even with these extensive powers, the improvements necessary to the water supplies of the small towns above mentioned may not easily be obtained, because of the excessive cost of materials and the high rate of interest charged for municipal loans. The difficulty thus reduces to the financial question of how to obtain money for these small towns at a reasonable interest rate.

This difficulty the Board of Health hopes to overcome by means of a project, now under consideration, whereby small municipalities may borrow from the Province, and at a low rate, the funds required for the needed improvements. If, as is expected, the legislature sanctions such a project, this most important remaining problem of water supplies in the Province of Quebec—the problem of the small town supply—may be susceptible of solution.

DISCUSSION

JOHN N. CHESTER: This paper deserves commendation, for it shows that if the administrative officers of the Province of Quebec can enforce the powers explained by the author, the Province is certainly in a better position in these respects than many of the states of the United States. This is not only true of the safeguarding of the quality of the water supplies but also applies to the financial methods of meeting the cost of really necessary work. In the United States we have the Bense act, in Ohio, intended to accomplish many of the things which the Quebec law provides for. The Bense act as

first passed was overthrown in the courts. It was then re-enacted in a modified form to meet the court's objections to the first form, and its status in this amended shape has still to be passed upon by the courts. If the Quebec law has been tested in the courts, their rulings will be of interest.

PRESIDENT DAVIS: To those in responsible charge of water works the financial problems are often the most troublesome to meet, and for this reason it will be interesting to learn if there is any restriction on the debt limit of the Province of Quebec which limits in turn the aid the Province can give to small towns for the betterment of their water supplies.

R. O. WYNNE-ROBERTS: Under such broad powers as the Provincial Board of Health of Quebec possesses, the financial problems that arise in meeting its order are likely to be interesting. For example, if a private company supplies the water and the Board orders the water to be filtered, is the additional cost of filtering to be met by the company out of its rates for unfiltered water, or are the rates increased, or does the municipality pay the additional cost and raise the money through its tax levies? Questions like these come up with works established for some years, but in the case of new works is it possible in the Province of Quebec for a town to build works using a polluted source of supply and assume no responsibility for the purification of that water until the Provincial Board of Health orders its quality improved?

THEO. J. LAFRENIÈRE: Mr. Chester's inquiry about the rulings of the courts on the Quebec law can be answered only partially as yet. The water supply of one town, Hull, was condemned and the case taken into the courts. The trial court condemned the supply and the town has carried the case to the Court of Appeals. Two other towns have refused to comply with the orders of the Board of Health, apparently waiting for the Court of Appeals to pass on the test case. A fourth town which refused at first to carry out the Board's orders has since changed its mind. As the law now stands in the courts, the Provincial Board of Health does have the power to compel a city to improve the quality of an unsafe water supply, and it will continue to exercise that power until the courts decide against it.

President Davis' statement regarding the assistance given by the Province in financing improvements of small water supplies introduces a subject which first received general consideration here when the improvement of local roads became imperative. In 1908 the Provincial legislature inaugurated annual subsidies to local municipalities which would undertake the maintenance of these roads, previously left to the property owners. In the same year it also instituted special annual grants to the municipalities which had surfaced roads. In 1912 the legislature voted to borrow $10,000,000, increased in 1915 to $15,000,000 and to $20,000,000 in 1916, for road purposes, part of which is loaned to towns to help them build gravel and macadam roads. The money was first loaned for 41 years at 2 per cent, less than the Province was paying for it; later the rate was increased to 3 per cent. These loans are made on the theory that the Province as a whole gains by the improvement of its minor subdivisions to such an extent that the use of a relatively small amount of public funds for supporting such local improvement is justifiable. The same principle is the basis of the United States laws allocating national funds to the several states to aid state road construction.

An investigation of the annual loss by typhoid fever in the Province was made some time ago, which showed the importance to the Province as a whole of improving the water supplies of the smaller communities. Our rivers are large and swift and it has not seemed necessary that sewage discharged into them should be purified. It is believed to be better sanitary policy, in view of all the local conditions, to purify the water supplies when necessary and to call upon the larger and wealthier cities to contribute toward the improvement of the water supplies of the small communities, just as they contribute to the improvement of local roads in rural districts. There is no legal limit to the funds that can be obtained in this way, as the decision rests wholly with the legislature. Similar laws are already in force in France and Italy.

In reply to the questions of Mr. Wynne-Roberts, it should be stated at the outset that the Provincial Board of Health had no authority until 1914 to order a private water company to improve its supply. Such authority as there was lay with the Public Utilities Commission, and a case arising under the law as it was prior to 1914 illustrates the conditions existing before that time. A water company was operating under a franchise which fixed the water rates

and provided that those rates could not be increased without the consent of the consumers. The supply deteriorated materially in quality through the pollution of the source, which the company could in no way prevent. The Public Utility Commission announced that it would order the company to improve the supply provided the consumers would agree to an increase in rates. A vote was taken and the proposed increase was defeated. The water supply, therefore, remained dangerous.

As a result of such conditions, the legislature amended the Public Health Act in 1919 so as to authorize the Public Utilities Commission to decided who is to blame for pollution of water supplies and to determine what additional compensation shall be paid to a water company for additional service which could not be anticipated when its franchise was granted. It is probable that the Commission will elect in at least some cases to allow the consumers to determine whether the additional cost of a pure supply shall be met by increased water rates or by an annual lump sum paid by the municipality.

Since 1901 it has been necessary for all new water supply projects, whether prepared by municipalities or private companies, to receive the approval of the Provincial Board of Health, and that approval was not given unless a safe supply was proposed.

WATER WASTE PREVENTION ON RAILROADS[1]

By C. R. Knowles[2]

In presenting this paper on the prevention of water waste on railroads, the author wishes to emphasize the fact that he does not appear merely as a consumer of water pointing out savings to be made only by reducing the quantity of water purchased but also as a producer of water with problems and troubles very like those of most water works officials. The sources of waste that may be enumerated and discussed at this time are as common to the supply furnished by a railroad company's pumps as to the supply purchased from a city water works plant.

The duties of a city water works manager and the duties of a superintendent of railway water service are along parallel lines, namely, the economical production of water adequate in quantity and satisfactory in quality. There is this difference, however, the manager of the private or municipal water works is in constant touch with his plant or plants and has direct supervision of their operation, while the plants on a railway system may be scattered over half a continent and are subject to the varying conditions peculiar to the territory in which they may be located. Consequently, some of the problems encountered in the prevention of water waste on railroads may be novel to the city water works man.

The author has been conducting a water waste campaign on the Illinois Central Railroad system for the past five years, endeavoring to impress upon officers and employes the value of water and the importance of water waste prevention. It is very gratifying to be able to report that this campaign has resulted in a material reduction in the waste and unnecessary use of water.

The total consumption of water on the Illinois Central system for the past five years, divided between water pumped by company

[1] Read before the Montreal Convention June 24, 1920. Discussions are invited and should be sent to the Editor.

[2] Superintendent of Water Service, Illinois Central Railroad Company, 6609 Greenwood Avenue, Chicago, Ill.

forces and water obtained from an outside supply, is shown in the following table:

YEAR	COMPANY PLANTS	OUTSIDE SUPPLY	TOTAL
	gallons	*gallons*	*gallons*
1915	15,300,000,000	2,986,000,000	18,286,000,000
1916	15,100,000,000	2,844,000,000	17,984,000,000
1917	14,000,000,000	2,754,000,000	16,754,000,000
1918	14,140,247,000	2,771,674,000	16,911,921,000
1919	12,967,260,000	2,655,740,000	15,622,000,000

It will be noticed that the consumption in 1919 was 2,664,000,000 gallons less than in 1915, while the average reduction for the five year period is 1,468,019,750 gallons. During the above mentioned period there was an increase of over 20 per cent in tonnage handled, which would indicate that a still greater reduction was made in the waste of water than is shown by above table.

The reduction in waste of water was accomplished by frequent water waste surveys at all points on the system, these water waste surveys varying from an investigation of a single hydrant at an outlying station requiring only ten or fifteen minutes time, to an investigation of the water supply at large terminals, sometimes requiring several days. As an example of conditions found in these water surveys a few instances may well be cited.

At a large Southern terminal a request had been made for authority for an expenditure of approximately $20,000 for new pumps and pipe lines, the request being based upon the assumption that the old pumps and pipe lines were too small to furnish sufficient water. A water waste survey disclosed the fact that 40 per cent of the water pumped was being wasted. When these conditions were corrected there was no difficulty in providing all the water required without any expenditure for additional equipment.

The consumption of water at a large office building used for general railway purposes had increased to approximately 8,000,000 gallons per month, and as this consumption appeared excessive, a water waste survey was made, with the result that the consumption was cut to approximately 2,000,000 gallons per month, a decrease of 75 per cent. The conditions at this point were due to general waste of water through almost every water facility in the building. For example, the controlling valves on the boiler feed water heater were

not operating properly, allowing unlimited quantities of water to pass through the heater to the bilge tanks where it was being pumped by an electric bilge pump to the sewer, this waste causing a threefold loss: First, the cost of furnishing the water; second, the loss of the coal required to heat the water which at the time the investigation was made was estimated to be the equivalent of 250 boiler horse power; third, an additional loss of electric current required to pump the water from the basement level to the city sewer, the bilge pump operating every 50 seconds at the time the investigation was made.

The urinal tanks, eighteen in number, were found to be flushing at intervals of from 50 seconds to 1 minute and 10 seconds. These tanks were of the 3-gallon flush type, probably 2,000,000 gallons of the water being used through these urinals. The controlling valves to the house tanks were in bad order, and the overflow from these tanks to the sewer was practically constant. In addition to these large wastes, there were a number of minor wastes of hot and cold water in the restaurant and other places in the building.

At a large engine terminal in the Middle West, the automatic valves controlling the water supplied to a large hot water boiler washing system were found inoperative, the consumption of water through the boiler washing system amounting to 300,000 gallons per day. Upon repairing and adjusting the valves the consumption decreased immediately and the daily consumption at the present time is approximately 60,000 gallons, a saving of 80 per cent of the water formerly used.

At another point the consumption was decreased nearly 3,000,000 gallons per month by adjusting and repairing automatic valves controlling water supplied to a boiler feed water heater and boiler washing system. In this particular instance the saving in heat applied to the water wasted was in excess of the cost of the water.

Numberless other instances could be cited where material economies in the use of water have been effected through these water waste surveys, those mentioned above being merely given as examples. The favorable results of the efforts towards prevention of water waste have not been easily obtained, as it is extremely difficult to convince the average railroad employe that he should exercise care in the use of water, for he cannot understand why one should worry about water with innumerable lakes and rivers on and adjoining the right-of-way. He cannot appreciate the fact that costly pumping

stations, reservoirs, water softening plants, storage tanks and pipe lines are necessary to deliver the water to the point of use.

The question has been raised, why the city water works manager should be interested in water waste prevention where the water was supplied through meter and the cost of such waste billed against the consumer.

In the first place it is to the interests of all public officers to prevent waste in any form, as their interests are not limited to the individual but to the community as a whole, and they recognize it as their duty to lead in campaigns for the elimination of all waste in all forms. The creation of waste benefits no one and adds nothing to the wealth of the country, institution or the individual. The city water works manager, realizing his duty to the public good in his efforts to eliminate waste, does not stop to question whether the waste goes to make up a part of his revenue or not. While there may be some few instances where a waste of water would increase the revenue of the water company without materially affecting the operation of the plant, unlicensed waste on the part of one consumer jeopardizes the supply to others and in justice to all, waste cannot be tolerated whether the waster pays for it or not. The water company cannot afford to encourage water waste, even by metered consumers, on account of the example set to those who are not metered and have no interest in keeping down the consumption. Excessive waste such as might occur with a large consumer such as a railroad company causes a great fluctuation in the demand. While a million gallons a day more or less would make but little difference with a plant pumping a hundred million gallons or so per day, it would create a serious condition with many smaller plants and doubtless in many places the correction of waste, leakage and unnecessary consumption would eliminate the necessity of expenditures for additional pumping equipment and distribution systems which is a serious matter under present material and labor conditions. This was appreciated by the Committee on War Burdens of the Water Works of the United States in its report in which it stated: "Pressure will doubtless be brought to bear to force communities to husband their water supply by reducing waste, leakage and even unnecessary consumption in order to curtail unnecessary investment in plants thus made necessary." While the above statement had direct reference to conditions arising from the world war, yet in a large measure they are just as true of conditions today.

The heavy migration to the cities in recent years has increased the urban population and the demand for water for domestic purposes to such an extent that many water plants are facing heavy expenditures for additional capacity at a time when it is extremely expensive and difficult to make such extensions. The reduction of waste will undoubtedly postpone these extensions until conditions return more nearly to normal.

A writer in *Engineering and Contracting* calls attention to the enormous waste of water by one of the largest cities in the world and goes on to show that the prevention of waste through installing meters at a cost of $13,000,000 would save an investment of $94,000,000 for additional equipment, not to mention a saving of $69,000,000 in coal, wages and repair.

As the equipment and appliances used in modern water works have increased in cost 50 to 300 per cent, there is no question that many water works plants are overworking their power houses to supply water to be wasted, and that many requests for appropriations are the direct result of waste beyond the control of the water works manager.

The annual consumption of water by the railroads of the United States is estimated at 900,000,000,000 gallons per year, 225,000,000,000 gallons of which is purchased from private or municipal water works plants and undoubtedly represents no inconsiderable portion of water pumped by these plants.

Many cities supply water at sliding rates, giving the large long hour consumer the benefit of the low rates. As the railways are such large consumers, the water which they waste is nearly all furnished at the lowest rates, which rates yield a comparatively small net profit to the Water Works Company. If this water was made available for distribution to a large number of small consumers the net revenue would be increased materially, thus benefiting both the railroad and the water company.

It has been estimated that 20 per cent of the water used on the railroads of the country is wasted. If this estimate is correct, we have 180,000,000,000 gallons of water pumped per year for no purpose other than to increase the expense of railroad operation and burden the pumping plants with an additional load. Using the figure of 25 pounds of coal for each 1000 gallons of water pumped, the waste requires the consumption of 2,250,000 tons of coal or more

than 6000 tons per day, and no doubt the part that this waste pays in the expense for additions to power and pumping equipment makes the coal bill look insignificant by comparison.

DISCUSSION

CHARLES HAYDOCK: The author has called attention to a very important use of water which all have not realized, and that is, the uses of the railways of the country.

For instance, on the Pennsylvania Railroad Lines East, there are about 87,000,000 gallons of water a day used for locomotive purposes alone. That does not include water which is used for coach washing, wetting down cinders, sanitary and domestic purposes in general. The quality of that water has not received the attention it warrants. A supply of pure, soft water is valuable for railroad uses because of necessity the steam locomotive operates uneconomically and the evaporation is at a rather high rate. The figures which the author has given would practically be substantiated by those on the Pennsylvania Railroad.

Water waste surveys on railroads probably pay just as well as in cities. In order to determine the uses of the Pennsylvania Railroad Company for locomotive purposes, as above noted, an investigation was made last fall. While this was not a water waste survey nor a campaign to reduce leakage, the information obtained during the investigation was sufficient to save its cost to the company many times over.

The greatest use is at yards and terminals, where lines and grades are subject to revision resulting in burying pipe under deep cover or exposure to attack by sulphur waters leached from cinders. Such conditions are favorable for excessive leakage unless the closest supervision is exercised, aided by suitable facilities for measuring the quantities used.

APPLICATION OF COPPER SULPHATE TO BASIN WALLS FOR CONTROL OF ALGAE[1]

By George F. Gilkison[2]

The object of this paper is not to introduce a new method for the control of algae, but rather to show how the Kansas City, Missouri, Water Department has, by changing the application of copper sulphate from the water to the basin walls, been able to control this annoying growth in their clear water basins.

Kansas City takes its water supply from the Missouri River at the Quindaro pumping station, 10 miles above the city. This station has a basin capacity of 90,000,000 gallons. The water is purified by sedimentation aided by coagulation and chlorination. It is then delivered to the Turkey Creek station, which is the distributing station. There are seven storage basins with a total capacity of 38,000,000 gallons located at different points throughout the city. It is in these basins that the algae growth causes the most annoyance. The basin becomes very unsightly, due to the fact that Spirogyra predominates and appears in long filaments throughout the basin. It also causes trouble in the meters by stopping up the strainers. At times offensive odors are generated due to the development of Anabaena and other blue-green algae.

The method first used to control this growth was to scrub the walls with long-handled wire brushes. This was not successful. The algae was torn loose from the walls and a large amount of it floated in the water and would attach itself to the wall again at the first opportunity.

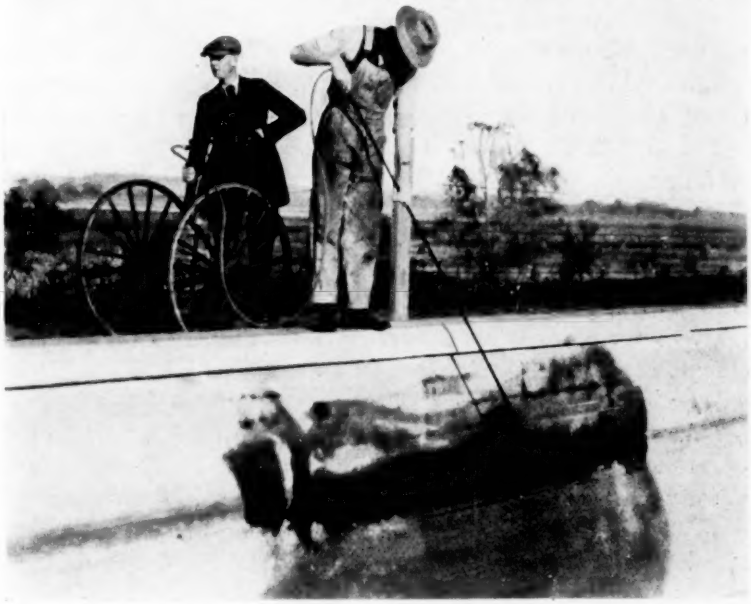
The next method tried was taking a known amount of copper sulphate in a sack and by means of a rope attached to it, dragging the sack along the wall on which the algae was growing. The disadvantages of this method were that the current caused by the sack would carry the copper sulphate solution away from the wall and

[1] Read before the Iowa Section, November 6, 1920. Discussions of this paper are invited and should be sent to the Editor.

[2] Chief Chemist, Water Department, Kansas City, Mo.

the strength of the solution being applied was unknown. This method also required a great deal of time, as the sack had to be drawn back and forth over the same wall to kill the algae growth.

To overcome the uncertainty of concentration, an experiment was made at the Quindaro station in which the copper sulphate was applied with the coagulant to the water. Copper sulphate being incompatible with aluminum sulphate, the two were dissolved in



Applying Copper Sulphate to Algæ-Covered Wall

the same solution and applied to the water as it passed over the weir by means of a perforated pipe line. The volume of water passing over the weir was known. Copper sulphate was added at this point, and in this way it was possible to calculate the parts per million in the basin. A start was made with 0.25 part per million and this was progressively increased to 1.5 parts per million. There was no apparent action on the wall growth until the concentration of the

copper sulphate rached 1 part per million, and at that concentration the algae at the end of the basin at which the copper sulphate was being applied was killed, but 1.5 parts per million were necessary to clear the far wall. This experiment was followed by an enormous increase in the bacterial count in the basin. The alkalinity of the water at the time of this experiment was 185 parts per million. While chemical analyses were not made on the effluent water from this basin, it is safe to say that most of the copper sulphate was lost by reaction with the alkalinity of the water. The following varieties of fish were present in the basin; catfish, carp, perch, drum, shad, and buffalo, none of which was killed.

Copper sulphate is now used in a known strength solution, and is applied directly to the algae growth on the basin walls. The water elevation in the basin to be treated is brought down below the algae line, which is about 6 feet below the normal elevation in the basins. This leaves the algae clinging to the wall. A paint spraying pump is attached to an 8-gallon keg which is mounted on wheels and equipped with a handle. A 5 per cent aqueous solution of copper sulphate is made by dissolving $6\frac{1}{2}$ pounds of copper sulphate crystals in 10 gallons of water and poured into the keg. While one man operates the pump another man directs the flow of the solution, which is delivered in a fine spray as shown in the accompanying illustration. After an hour the walls are scrubbed with a wire brush and the basin is again filled to normal elevation.

One gallon of this solution will cover 125 square feet of wall surface and can be applied by two men with a spraying machine in four minutes. By carrying out this method every two months during the warm weather, it is possible to keep the basin walls comparatively free from algae.

LIFE NOTES AND SALE, WATER SYSTEM AT COUNCIL GROVE, KANSAS[1]

By Louis L. Tribus[2]

This paper, in presenting notes about a small western water system, gives:

(a) A running history, typical of selfish and unjust official treatment of a public utility that had done more than its fair share for public convenience and comfort.

(b) Further data from water treatment records, supplementing those published earlier by this Association.

(c) Schedules of rates: old, proposed and recently made effective.

(d) Sidelights upon Kansas public utility laws and their interpretation.

(e) A valuation of the plant in 1911, which, with its depreciation table and accompanying comments, will make one more addition to cases on record.

The whole is woven into what has been a sad story for the owners, but perhaps may prove an instructive one to water works operators.

Historical.—April 30, 1919, marked the end, as a private corporation, of the water works system in the small city of Council Grove, Kansas. In March, 1915, this Association published a brief description of the then recently remodeled water works station and new treatment plant. In December 1918, a report was made of about three years' operations, giving some facts and suggestive data about treatment of the water up to February of that year.

Now, with the passing to municipal ownership, further changes in plant will be made and new sets of records started, which it is hoped will lend themselves to further items of interest in coming years.

Taking the same form of presenting data as in the second paper[3] mentioned, it is interesting to note the confirmation of the former

[1] Presented at the Montreal Convention, June 23, 1920. Discussion is invited and should be sent to the Editor.

[2] 15 Park Row, New York.

[3] Journal, December, 1918.

ideas as to action of the water under treatment, with indication perhaps of better response to the chemicals, due to greater knowledge of its characteristics.

Figure 1 shows the relationship between alkalinity and grains of alum used. Usually low alkalinity indicates a high stage of water, even flood conditions, consequently as a rule high turbidity and therefore need for coagulant. In each case cited, the resultant effluent indicated zero turbidity.

But this review is more for the sake of recording in its historical phases, the life history of the works, from a business standpoint, than from an operative outlook.

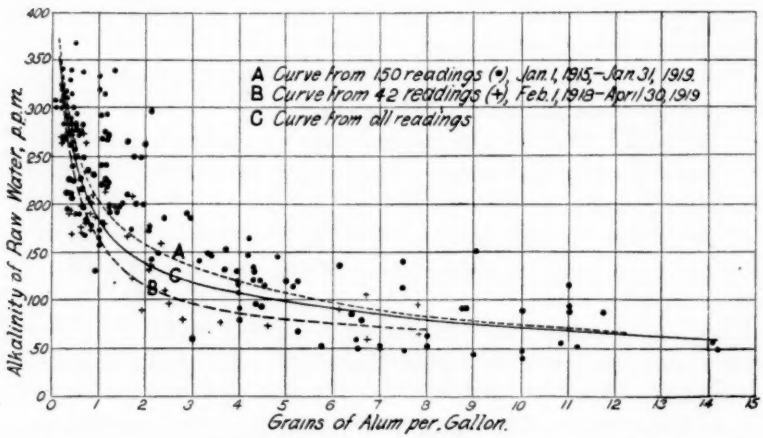


FIG. 1.—RELATIONSHIP BETWEEN ALKALINITY OF RAW WATER AND QUANTITY OF COAGULANT.

Its history has been duplicated many times, in fact, but rarely written up, for owners of such plants are usually too glad to forget the past when once free from their burdens, and their losses have been scrapped.

From about 1880 to 1895, there thrived (i.e. for a time) a group of men, who, though philanthropically desiring to benefit the public by the introduction of public water systems, were not backward in seeking good fat contracts and even in some cases so padding the costs as to very liberally line their own pockets. If one wished to be so uncharitable as to imagine such a condition, to also help occasional worthy city, town or village officials to keep the wolf from the door. In these days the spirit may be equally willing to conduct

the same kind of business, but conditions have so completely changed that the same procedure is but rarely possible. Most of the plants thus built have changed owners, either through bankruptcy or sale at a sacrifice to other investors or to the municipalities at interest.

Certain groups of operators built first-class, intelligently planned systems, hoping to make quick profits in the financing. Others did but fair work and unloaded their enterprises as soon as possible, on a basis of profitable municipal contracts and rosy outlook for business, together with padded bills of cost. A third and too numerous class built without anything first class connected with the scheme except the cigars offered when cultivating the franchise field.

In retrospect let us remember, there were no Public Utility Commissions in existence; no legislature had commenced to regulate semi-public business; city officials gave little thought to their public-service taxpayers, as such, except, perchance, to exact tribute when granting franchises and entering into long-time contracts. The States generally had corporation laws, under which clever men organized companies, and in some instances legislatures granted special charters of great value to their holders, but not safeguarded to the public.

It was not a day all of evil, for many a community can heartily bless its public spirited men, who put their own good money into helpful utilities not knowing the uncertainties of return. The uncertainties became unfortunate facts, too, for often not only was the investment unproductive but ultimately largely lost.

Due to the vast development of that fifteen years period, and somewhat for the next ten, with the exploitation of the public and legitimate investors by unscrupulous financiers, the public woke up and made up its mind to curb the utility promoter and his corporations. Then came the Public Service or Utility Commissions and the promulgation of laws to protect the people from avaricious exploitation, by curbing investment, and limiting franchises, and by the regulation of operations. To be the owner of a public utility was to be allied with "Wall Street Robbers," or at least to be suspected of profiting by almost sure crime. And scarcely to be wondered at, with the uncovering of huge traction scandals and lesser milkings of the public cow.

During the past five years, after many a financial wreck had unnecessarily been brought about, a little real common sense has crept into Court decisions and those of Public Service Commissions,

their "orders," indicating a duty to invested capital which serves the public, as well as to the public alone.

In these recent war days, with the soaring costs of labor and materials, there have been many instances of men in high places, whose only thoughts were as demagogues (not demi-gods, as they consider themselves), to stand up for the "peepul," while great tax-paying, public-serving plants were going to ruin and receiverships. Receiverships, however, are very welcome to such classes of officials, for friends secure many a fat retention, and plants sold under foreclosure sometimes fall into hands, not unfriendly, for rehabilitation, and another course of financing, operating and wrecking.

This is not to be, however, a pessimistic review but to indicate the general surroundings or furnish the atmosphere for the particular small plant's history of immediate interest.

In 1887, certain promoters, now passed away so that their names will not be mentioned, secured a franchise for furnishing water from the Neosho River to the small city of Council Grove, in the central eastern portion of Kansas.

With the franchise, went a 25-years contract for fire protection service, at a surprisingly just annual rate, viz., $70 each for the first 35 hydrants (the original installation) and $55 each for those beyond that number. The city was also bound to certain conditions as to renewal of franchise or an alternate obligation, to buy the plant by agreement or appraisal. A part of the enacting ordinance was the provision that within a given period (before the works should be put in operation) a fixed schedule of rates should be established by mutual agreement.

Within the designated time, the rates in use in the large city of Saint Louis were proposed and accepted, in spite of their absolute unsuitability for a small town. The city officials knew only that the rates were low, the promoters did not care for they had already practically arranged to unload the plant at par for a bond issue of $63,000, while not putting over $50,000 at the outside into the plant itself, even allowing for engineering, legal and carrying charges. Who divided the $13,000 or more would be purely speculative at this date, and perhaps an uncharitable quest at that.

This much be it said, however, the plant, what there was of it, was well built and of good materials, but neither the promoters nor the city officials thought far enough ahead to plan for any treatment of the water so as to insure its potability at all times.

When it is mentioned that the water contains during the not unusual freshet periods, detritus indicating a turbidity of over 5,000 parts per million, and that up to very recent years the direct nearby watershed of the Neosho included several cattle yards for winter feeding, the need for purification can well be imagined.

However, the promoters did not care; the city officials could brag about reduction in fire insurance rates; and who wanted to drink water anyhow; this was in Kansas before prohibition days, and the rate schedule indicated the 57 variety of places where liquor could be secured.

Houses had no plumbing or sanitary conveniences; the rainwater barrel, with its mosquito inhabitants, and the back yard pump (albeit with scanty supply) had sufficed before; why not thereafter; the lawns and the young trees could be watered (and fertilized), the streets be flushed and perhaps the entrained mud might even help to put out fires.

In the original contract, two inconsistent paragraphs appeared; one calling for the use of Neosho River water as the supply to be furnished, in accord with specific plans, approved by the city officials; the other requiring the delivery of pure and wholesome water.

Inasmuch as the approved plans contemplated pumping and delivering raw untreated river water, it did not need an expert to see that the second condition could not be met, except in the rare periods, immediately following a winter's flood coming from snow covered frozen ground. The author has seen such a condition and drank of the soft clear cold water with pleasure.

Operations continued, under these peculiar conditions for about ten years, when the city officials began to attack the company for "non compliance" with contract. Rather than have protracted litigation and thinking that some new business might be secured, the company agreed to make changes and acquired some special rights. It increased the river storage by the erection of an overflow dam, which served also as a highway ford except in flood times, built an annex to the pumping station and installed a New York mechanical pressure filter, spending well towards $10,000 in so doing. When carefully handled, with proper doses of coagulant (alum), this filter rendered excellent service until the consumption of water finally overtaxed its capacity, 250,000 to 300,000 gallons per 24 hours.

By this time, the franchise period of 25 years was drawing towards a close, and no better service rates had been secured; and there was serious doubt as to the kind of action the city officials would take. Consequently the Company was disinclined to invest any further capital in a losing venture. There had been some current investment for additional pipe lines, but supplemental hydrant rental guaranteed a return thereupon.

In 1906, after about 18 years operation, the company passed under foreclosure, through sheriff's sale, into the hands of two of the original bond holders, who thereafter handled the system for themselves and virtually as trustees for the other bondholders, until the final transfer to the city in 1919.

The plant had earned its operating expenses, but never the full 5 per cent upon the outstanding bonds, and of course nothing upon the stock, which only represented water in any event.

According to franchise terms, in the spring of 1911, the Mayor and his two associated City Commissioners served formal notice upon the owners, that upon the expiration of six months the city would exercise its option and take over the water system, according to one or the other of the methods prescribed for so doing. The document of "notice" was signed by each of the officials, and the City Clerk and was stamped with the city seal. Before this formality some negotiations had been conducted as to a sale, but nothing came of them.

To follow up the matter of acquisition either by agreement or by arbitration, the then Mayor, accompanied by special counsel, came to New York and so far as they could bind the city, filed a written statement agreeing to pay $58,000 for the system as it stood.

Without any knowledge by the owners, the city officials had secretly caused a valuation to be made by reputable engineers, whose appraisal justified a $58,000 payment. The matter went to a vote of the people and certain opposition campaigners, however, secured the rejection of the proposition.

The appraisal as presented to the people was as follows.

Valuation of Council Grove Water Works

ITEM NAME	COST OF DUPLICATION	DEPRECIATION	PRESENT VALUE
1. C. I. P. Streets Main	$16,993.60	$849.68	$16,143.92
2. Special casting	1,010.60	50.53	960.07
3. G. I. P. in Dist. Sts	479.76	71.97	407.79
4. Tees and Spls. for G. I. P	18.30	2.74	15.56
5. Gate valves in Dist. Sys	526.45	152.67	373.78
6. Street boxes	99.00	4.95	94.05
7. Fire hydrants	1,431.00	171.72	1,259.28
8. Pipe laying	6,935.28	328.33	6,606.95
9. Setting fire hydrants	121.50	14.58	106.92
10. Setting gate valve	54.20	15.72	38.48
11. Suc. pipe, valves, Sp. at pumping sta	284.05	59.65	224.40
12. Dis. P. V. S. at sta	384.55	80.76	303.79
13. Filter pipes, V. & spls	263.05	23.67	239.38
14. Filter plant	2,497.00	610.00	1,887.00
15. Steam boiler plant	1,096.00	678.96	417.04
16. Setting boilers	942.00	480.42	461.58
17. Steam pipe, exhaust pipe, fittings, etc	361.94	104.96	256.98
18. Steam Auxiliaries	190.00	74.10	115.90
19. Pumping machinery	2,570.00	745.30	1,824.70
20. Station Miscellaneous	45.30	9.06	36.24
21. Station building	3,426.70	411.20	3,015.50
22. Coal house	244.63	73.39	171.24
23. Water tower	4,862.10	1,410.00	3,452.10
24. Bradford dam	1,713.60	171.36	1,542.24
25. Bank protection	240.00	00.00	240.00
26. Mission dam	6,033.00	100.00	5,933.00
27. Small wells and Auxiliaries	446.75	223.37	223.38
28. River intake well	2,195.40	150.00	2,045.40
29. Drain title	203.90	20.39	183.51
30. C. I. P. & Spls. on hand	350.17	00.00	350.17
31. Miscl. tools and supplies on hand.	500.16	00.00	500.16
32. Water meters	180.50	45.12	135.38
33. Office fixtures	98.00	00.00	98.00
34. Real estate	500.00	00.00	500.00
35. Engineering and Supv	2,800.99	354.32	2,446.67
36. Lost interest during construction.	1,001.65	124.81	876.84
37. Going value			
Total exclusive of going value	$61,101.13	$7,613.73	$53,487.40

So it will be seen that the experts employed by the city fixed the value of the plant at $53,487.40 plus the going value; that is, the assemblage of all the parts and the plant in full operation. At the New York conference it was considered that the "going value" would add 12½ per cent to the estimate of the experts, which raised the other total value to something over $60,000, from which the water company agreed to make such reduction as cut down the total asking price to $58,000. To make the valuation of greatest

use, the length of life of each part should be known, but the following will give a fair clue to an understanding of the figures given.

The pumps, boilers and their protecting buildings; the intake well and standpipe and 3½ miles of cast iron mains from 4 to 12 inches diameter, dated back to the first construction in 1886. The pressure filter and its building, large enough for a second filter, and the Mission dam dated from 1897. The additional two miles of mains, chiefly 6 inch, were laid between 1890 and 1900, averaging perhaps 1895.

Inventory of cast-iron pipe lines (1910); 1937 feet 12 inch, 3716 feet 10 inch, 3965 feet 8 inch, 9760 feet 6 inch, 7070 feet 4 inch; 15 tons of specials; 54 double nozzle fire hydrants. The pipe cost can be taken as $32.50 per short ton f. o. b. Council Grove, and specials at 3 cents per pound. From the review of depreciation in the report there may be quoted the following:

> In order to determine the condition of the cast iron pipe system, openings were made and the pipe uncovered and examined in a number of places selected at random at various parts of the system. This was done in order to determine sizes of the mains, etc. In every case where an opening was made, the pipe was found to be in excellent condition externally.
>
> Twenty-four places were thus examined. A cut of 3.5 feet was shown to be a fair average. The internal condition of the pipe was determined by the measurement of friction in a number of places, from which it was determined that the tuberculation is practically negligible, inasmuch as the results of the friction tests indicate no more loss in friction head than is ordinarily found in new cast iron pipe of average character.

The appraisers used 100 years as the assumed life of the pipe, and for computations took the sinking fund method, compounding annually at 3 per cent

The galvanized pipe, examination indicated, had fairly a life of 25 to 30 years, gate valves, 50 years; fire hydrants, 75 years; boiler plant, 35 years; pumping machinery, in excellent condition, 50 years; buildings, perhaps 60 years; stand pipe 50 years.

The other elements of the plant were of minor importance. The estimates given, must be considered in light of the climate (short winters and long hot summers), hard water not acting readily on iron, and a limestone soil conducive to protecting rather than destroying iron.

The alternate franchise method of "purchase by arbitration" was then in order. The owners named two appraisers, but the city

officials could not muster up courage to be commercially honest, and even repudiated their formal notice to buy. Furthermore they failed to pay hydrant rental earned before the expiration of the franchise period.

The owners brought suit for moneys thus retained and to enforce completion of the sale, or else compliance with the remaining original franchise conditions.

The Court did not rule upon the hydrant claim, but suggested adjustment, and ordered the city to tender a renewal of franchise, for 20 years upon the identical terms of the former agreements, including hydrant rates contract.

The city made the offer and informally but positively agreed (through a new set of officials) to accord better rates and readjustment of various matters if the owners would do certain things, also to pay the greater part of the defaulted hydrant rental and promised to pay in full and promptly thereafter. The owners, relying on the "gentlemen's" agreement, accepted the offers and spent about $20,000 in making the betterments, described in the author's paper of March, 1915, before this Association.

The rates to be sanctioned were to provide operating expense, depreciation and a profit of not less than 8 per cent, in accordance with Kansas laws.

As soon as possible after the improved plant was in satisfactory operation and in accordance with the aforesaid agreement an ordinance was presented, which, if enacted, would have permitted charging upon a proper and suitable basis, with minimum rates as a feature.

ITEM	RATES IN EFFECT FROM BEGINNING OF OPERATIONS TO SALE IN 1919	RATES ASKED BY OWNERS IN MARCH, 1918, SUBSTANTIALLY THE SAME AS ASKED IN 1915 (FOLLOWING NEW CONSTRUCTION)
Minimum per year		$12.00
Ale cellar	$20.00 to $100.00	
Bakery, each oven	10.00 to 50.00	$12.00 to $30.00
Barber shop, first chair	10.00	15.00
Barber shop, each additional chair	3.00	5.00
Bath, without heating apparatus	3.00	
Bath, with heating apparatus	5.00	
Bath, public heating apparatus	15.00	
Bath (tub or shower), first in private residence		6.00
Bath, each additional		3.00
Billard saloon—each table	3.00	6.00
Blacksmith shop—each fire	3.00	6.00
Boarding house, per room	1.50	
Book bindery, per hand $2.00, but no license less than	15.00	
Brickwork, per thousand	0.10	
Brickyard, each gang of hands	20.00	
Buggy	2.00	
Camphene, each barrel manufactured	0.10	
Candle manufactory	100.00 to 1000.00	
Candy manufactory	15.00 to 100.00	
Carriage	2.00	
Churches	Free	
Cigar manufactory, per hand $2.00, but no license less than	10.00	
Cisterns, per 100 gallons	.06	
Club room	20.00	
Coffee saloon	15.00 to 100.00	
Confectionery	15.00 to 100.00	
Dental office	15.00 to 30.00	
Distillery, each barrel distilled	.10	
Dram shop	20.00 to 100.00	
Dyeing and scouring	25.00	
Forge	3.00	
Foundry, each fire	3.00	
Fountain, running not more than four hours per day	25.00	
Garage as "garage" or "hose"		12.00
Grocery store	10.00	
Hall	5.00 to 30.00	
Halls or theatre (minimum)		16.00
Hand basins, in private residence		4.00
Hand basins, in church or library		6.00
Hand basins, in office, store or shop		12.00
Horse	3.00	
Hose, for private stable	5.00	
Hose, for livery or sale stable	50.00	
Hose, for washing pavement, per running foot	.10	
Hose, for sprinkling streets, including sidewalks, per running foot	.10	

ITEM	RATES IN EFFECT FROM BEGINNING OF OPERATIONS TO SALE IN 1919	RATES ASKED BY OWNERS IN MARCH, 1918, SUBSTANTIALLY THE SAME AS ASKED IN 1915 (FOLLOWING NEW CONSTRUCTION)
Hose, for sprinkling garden and lawn, not less than ¾ inch, with muzzle $\frac{3}{16}$ inch, per square yard, ½ cent but no license less than	$5.00	
Hose (not to exceed ¾ inch drain), in private stable or garage		$12.00
Hose, lawn or street sprinkling, per sq. yard 1 cent, minimum charge of		6.00
Hotel, per room	1.50	
Ice cream saloon	15.00 to 100.00	
Kitchen sink		8.00
Laboratory	25.00	
Laundry, with 3 hands or less, $20.00, and for each additional hand $5.00 additional		
Livery stable, per stall $2.00 but no license less than	25.00	
Malting, per bushel	.01	
Mule	3.00	
Office	5.00 to 30.00	
Oyster saloon	15.00 to 100.00	
Packing House	50.00 to 500.00	
Pantry sink		8.00
Photograph gallery	20.00 to 50.00	
Plastering, per square yard	½ cent	.01
Pool room, each table	3.00	6.00
Porter cellar	20.00 to 100.00	
Printing Office, per hand $2.00 but no license less than	15.00	
Printing office, per hand (exclusive of power)		4.00
Residence, occupied by one family only		
2 rooms or less	3.00	
3 rooms or less	4.00	
4 rooms or less	5.00	
5 or 6 rooms	6.00	
7 or 8 rooms	7.00	
9 or 10 rooms	8.00	
11 or 12 rooms	9.00	
13 or 14 rooms	10.00	
15 or 16 rooms	11.00	
17 or 18 rooms	12.00	
19 or 20 rooms	13.00	
With more rooms, for each additional room	.50	
Residence, occupied by more than one family, in addition to the rates charged for residence occupied by one family only, 50 cents per year for each additional person not a member of the family		
Restaurant	20.00 to 100.00	

ITEM	RATES IN EFFECT FROM BEGINNING OF OPERATIONS TO SALE IN 1919	RATES ASKED BY OWNERS IN MARCH, 1918, SUBSTANTIALLY THE SAME AS ASKED IN 1915 FOLLOWING NEW CONSTRUCTION)
Saloon	$20.00 to $100.00	
Sale stable, per stall $2.00, but no license less than	25.00	
School	Free	
Shop	5.00 to 30.00	
Slaughter house, for each animal killed 5 cents, but no license less than	25.00	
Slaughter house, each animal killed		$ .20
Stable, private, including one horse, mule or cow, and hose washing		8.00
Soap manufactory	100.00 to 1000.00	
Soda manufactory	50.00	
Spirit gas, each barrel manufactured	.10	
Spring wagon	2.00	
Sprinkling streets, with carts, per block of 300 feet	10.00	
Starch manufactory	50.00	
Steam boilers, per square foot fire surface	.40	
Stock yard	25.00 to 500.00	
Stone work, per perch	0.05	
Store	5.00 to 30.00	
Tannery, per vat $6.00, but no license less than	25.00	
Tenement, per room	1.50	
Tobacco manufactory, per hand $2.00 but no license less than	10.00	
Urinal—for private residence	10.00	4.00
Urinal—not in private residence	20.00	
Urinal—in church or library		6.00
Urinal—in store, office, hall or shop		12.00
Vault	5.00	
Vinegar, each barrel manufactured	.05	
Washing bottles	25.00	
Washing barrels, per barrel	.05	
Washing meat, not less than	20.00	
Wash tub		4.00
Wash tub, each additional tub		2.00
Water closet	5.00	
Water closet in hotels	10.00	
Water closet in private house, church or library		6.00
Water closet in boarding house, store, office, hall or shop		12.00
Whitening shop	15.00 to 30.00	

Meter rates in effect

When the quantity used averages 1,000 gallons per day or less	3 cents per 100 gallons
From 1,000 to 2,500 gallons per day	2½ cents per 100 gallons
From 2,500 to 5,000 gallons per day	2 cents per 100 gallons
From 5,000 to 10,000 gallons per day	1¾ cents per 100 gallons
From 10,000 to 25,000 gallons per day	1½ cents per 100 gallons
Exceeding an average of 25,000 gallons per day	1¼ cents per 100 gallons
Exceeding 100,000 gallons per day	1 cent per 100 gallons
For manufacturing purposes only, without regard to quantity used	1¼ cents per 100 gallons

Meters rates asked for in 1918

Covering water delivered in: Court House and Jail.
Dental offices; Dyeing and Scouring Establishments.
Fountains.
Garage (Public).
Hose in Livery Stables, Sales Stables or Public Garages (not to exceed ¾-inch diam.).
Ice Cream Saloon.
Laundry (Public); Livery Stable or Garage.
Photograph Gallery.
Restaurant.
School, Soda Fountain, Sprinkling Carts, Stable (Public), Steam boilers, Stock yards, Store (meter or by fixture rates).
Bills payable within ten (10) days of presentation.

Minimum charges cover expense of meter reading, and permits of the use of a monthly quantity of water up to 2,500 gallons.

Minimum per month, if meter is owned by consumer	$1.00
Minimum per month, if meter is owned by company	1.25
⅝-inch meter or less	1.25
¾-inch meter or less	1.50
1 -inch meter or less	2.00
1½-inch meter or less	3.50
1¾-inch meter or less	6.00
2 -inch meter or less	10.00
First 20,000 gallons per month, each 1000, (this includes the quantity allowed under minimum charge)	.40
Next 30,000 gallons per month, each 1000	.35
Next 50,000 gallons per month, each 1000	.30
Next 100,000 gallons per month, each 1000	.25
Next 300,000 gallons per month, each 1000	.20
Next 500,000 gallons per month, each 1000	.16
Next 1,000,000 gallons per month, each 1000	.13
Next 2,000,000 gallons per month, each 1000	.11
Succeeding quantities, each 1000	.10

Special contract

Fire protection (private or corporation), for hydrants or sprinklers.

From the date of presenting the suggested draft of ordinance in September 1915, (figures as amended in March, 1918, given above) until the final acquisition of plant, the officials denied consideration, though advised by the city attorney of the two essential facts, (a) that the petition was duly before the Mayor and Commissioners and (b) that they had undoubted legal right to either enact or reject the ordinance.

The matter was pro forma referred to a committee, but so far as any record appears the committee never reported.

After waiting a reasonable length of time, and offering to put all facts of receipts and expenses before the officials, of which proffer they did not avail themselves, a carefully prepared brief was drafted, including the history of the plant, valuations, negotiations for sale, franchise terms, contracts, rates existing and proposed, capital and operating costs and earnings and other information.

This was sent to the Kansas Public Utilities Commission, with a petition that inasmuch as the proper authorities of the city of Council Grove, after being duly apprized of all the facts and conditions, had neglected to either pass, modify, reject, or even confer upon the tendered rate ordinance, after a due period of time had elapsed, therefore the owners, in justice to themselves and really to the people of Council Grove, asked a "review" of the case and an order to the city officials to establish or accept a new schedule of reasonable rates. This was based upon a certainly just, though perhaps not a strictly legal, interpretation of the law, that "inaction," practically established "action." The chairman and counsel of the state commission considered the matter and ruled that as the city officials had not actually acted, there was nothing tangible upon which to base an appeal, thus rejecting the owner's argument, and further ruling that as the water works were wholly within the limits of one municipality, the Utilities Commission had no original jurisdiction. A quotation from a letter of one of the Commissioners dated March 23, 1916, may be interesting as suggesting the arguments presented and answering them in order.

> You state that, under our letter (an earlier one) and its quotations, your client would seem to be shut off from any appeal because it supplies water wholly within a municipality. You further say that you can scarcely believe that the intent of the law is to deprive a public utility of its just rights, when a duly constituted lower authority virtually denies them.
>
> Your presentation of this matter is theoretically correct in one sense, but the trouble is that there is a specific statute, excluding this Commission from any jurisdiction over utilities serving but one municipality. The only exception to this is the provision for *appeal*, to which I will refer later. As to this utility and this City, under the statute the City is not a lower authority than is the Commission, nor is it the intent of the law to deprive a public utility of its just rights. It is quite probable that if this utility is deprived of its just rights, and about that, of course, we can express no opinion, a good lawyer can find a way to obtain relief.

By way of comment on the last sentence, statutes are usually

drawn by lawyers and provide good bases upon which to furnish employment to others. Is it not about time that they began to be drawn with intent to prevent rather than foster litigation? Again quoting from the letter:

> Touching Section 354 of Page 134 of Caster's Compilation (Kansas Public Utility Laws) which, as you say seems to give the right to the Commission to enforce proper rates, if the public is not well treated and conversely, the right should be implied to give the utility justice if the public does not treat it properly, through the duly chosen officials, we can only say that this Section, like all others, can apply only to the utilities over which the law gives the Commission jurisdiction. As to those utilities, over which no jurisdiction is conferred, it can have no application.

As the commission had last say in the case, that view had to be accepted, but the author could not read the statute in question so narrowly as to exclude the particular matter in hand from the broad power jurisdiction of the commission under the "appeal" clauses: quoting again:

> Coming now to the provision for appeal, I desire to call your attention to the language of Section 372 upon pages 142–143 and 144 of Caster's Compilation. You will observe that the appeal provided for is only given in case the city passes some ordinance or resolution. In other words, the appeal is given from some action, not because of a failure to act on the part of the City Council or other municipal authority. The jurisdiction, which is given over water companies and cities is "Subject only to the right to apply for relief to said Public Utilities Commission as hereinafter provided in Section 33 of this Act." A failure to act may be tantamount to the same thing in fact, but it is not so, as we understand it, in law.

The company did have another line of procedure of which it was fully advised, but largely involved in red tape, which would have probably brought the case ultimately to the Public Utilities Commission on direct appeal, as then warranted by "action" and not "inaction," with a choice train of counsel fees in the bargain. That course involved a plea in the United States Circuit Court (the owners being non-residents of Kansas) for a mandamus to require the mayor and commissioners to act upon the profferred ordinance. The merits of the subject would have had to be presented and then if the Court issued an order upon the authorities to act and they failed to accord the rates essential to solvency, the same appeal to the State Commission would have followed.

Such is law, or perhaps its interpretation. Certain features concerning personnel of the ownership, residence in the East, lack of general business interest in utility management, well advanced

years, etc., made for long-suffering, courteous reluctance to litigate and the desire instead to get rid of the whole responsibility and long-distance operation, even at a great sacrifice. Some of the City officials and a few other citizens fully understood the situation and equally rejoiced in taking selfish advantage of it, even perchance as sometimes happens also in our largest cities. Among the incumbents in office in Council Grove, there were exceptions some of the time during the 33 years of private ownership, a few who really desired to be just and fair. In the later negotiations one there was who conspicuously stood for the right. If any names were to be mentioned in this review, the author would like to publicly note his as worthy of better associates.

In passing from that phase of the subject it should be mentioned that the occupant of the mayor's chair in these later days was the incumbent at the time of granting the original franchise and making the general contracts and rates, though several other men had reigned in between. He was not, however, the one who was forced by the court to tender a renewal of franchise, but the one who failed to carry out the fair understanding made with his predecessor as to rates, and the chief opponent to paying a decent price for the plant.

Several times following 1911, the city officials asked for selling figures, but though figures were named, in light of subsequent events the inquiries were evidently not made with any desire to purchase at a fair figure.

In 1918, however, came the climax; a drought, such as had rarely been known even in that region of floods and dryness, practically dried up the river, except for such water as remained in the successive pools, dammed back by the cementitious-gravel riffles, and a little in the two storage reservoirs

The owners went way beyond their duty in trying to keep the supply going, resorting even to peripatetic pumping, emptying one pool after another so that there might be a little inflow to the lower reservoir, from which the main pumps might get some water. In spite of all efforts, for part of one day, no water could be secured and the whole system was practically empty. For several days prior thereto the level had been too low for passage of the water to the main treatment works, so resort was had to special sterilization solely. A citizens committee was organized, taking the matter out of the hands of the officials, and the author, at its urgent request, hastened to Council Grove to discuss matters. A description of conferences would make interesting reading for a sensational paper

and have caused the traditional horse to laugh, had it not been for the real seriousness of the case.

The owners were threatened with all kinds of punishment; the mighty State Board of Health was expected to require all sorts of impossible things, but without water in the river, what could orders accomplish if issued? As a matter of fact, after full examination of conditions and the consideration of an exceedingly unfair and misrepresenting document, that eminent Board excused the owners for having abandoned the treatment works without first securing the Board's consent, and failed even to advise action on any other point or make comment on the many charges preferred. It is only fair to keep in mind, however, that homes were in danger, that water was almost an unknown quantity, that sanitary conditions were likely to become thoroughly bad and that apparently the water plant owners were the only ones who had a legal right to do anything. Some there were who realized that the fault lay at the door of their own officials in the first place, and liberally blessed them in the choicest Kansan.

While the conferences several times a day were in progress, bountiful rains began and the danger period was over, but the more thoughtful citizens realized one thing at last, that the worm had turned, and danger might again be faced. The author, fully empowered to make agreements, in view of the years of arbitrary one-sided unfair treatment by the city officials, a treatment tacitly, at least, upheld by the voters, absolutely refused to consider an investment of one additional dollar for extra storage or any other betterment, no matter how much it might be needed, or do more than barely operate the plant as long as income equalled expense. Attention was called to the mounting costs of labor, fuel, chemicals, repairs, etc. so that a complete shut-down might soon follow, with plenty of resulting expense to the city.

As the only alternative, the owners would consider an immediate sale of the plant just as it stood. Then ensued a trade, beside which even a Kansas horse trade became insignificant. Finally, after making a compromise offer exceedingly liberal to the city, without acceptance; announcement was made at 11 a.m. that at about 2 o'clock a train eastward would bear the author; that full legal steps (already planned with counsel) would be at once instituted, looking to forcing adequate service rates based on the real value of the plant and to the full limit specified by law, and, further, that not one cent would be expended to protect the city against

further droughts until after such further revised rates should have been first duly authorized as would insure full proper return upon such investment.

The result was a hurried conference and a request for time to talk over the offer with a few more bankers and tradesmen and the city officials. This was granted, but the author mentioned his intention to take that particular train in any event. The final result was the acceptance of the proposition by the committee on October 30, 1918, at about 12.15 noon. As the committee was composed of a large enough number of the best citizens and leading business men, their agreement could be depended upon. Nevertheless backing and sidestepping marked official action, until a final affirmative vote of the people was taken on April 1, 1919, and the plant was taken over on May 1 following.

The plant had cost the owners in excess of $110,000, of which about $95,000 actually represented tangible value. Its depreciated and appreciated value was fully $75,000; yet the city secured it for $42,500.

The several successive local superintendents of the works had served with great and careful faithfulness, particularly the last incumbent, a young engineer, who deserves the highest praise for his intelligent care and efforts to make the best of a bad case. The city retained him in charge after acquiring the system, and at once assigned to him the task of preparing new operating regulations and a higher rate schedule which became effective on June 17, 1919, as follows:

All metered services shall pay a minimum charge of 60 cents per month and shall be allowed 2000 gallons of water for such minimum charge.

For amounts in excess of 2000 gallons per month the following charge shall be made. From 2000 to 5000 gallons per month 30 cents per thousand.

From 5000 to 10,000 gallons per month 25 cents per thousand.

For all amounts over 10,000 gallons per month, 20 cents per thousand.

In addition to the above rates there shall be a manufacturers rate of 12½ cents per thousand gallons regardless of the amount used. Also such other special rates as the City Commission may fix by contract.

All unmetered services shall pay a flat rate according to the following schedule:

Minimum rate for any fixture or use, 75 cents per month.

For all additional uses of fixtures as follows:

Bath tub, without heating apparatus, $0.25 per month.

Bath tub, with heating apparatus $0.42 per month.

Brick work, per thousand $0.10.

Concrete, per cubic yard $0.02.

Plastering, per square yard, $0.0½.

For domestic use, regardless of fixtures, not less than $0.50 per month.

Stone work, per perch $0.05.

Water closet, $0.42 per month.

Lavatory, $0.20 per month.

Sprinkling; Any person desiring to use water from any service for the purpose of sprinkling or irrigating, shall first install a meter in such service and pay the regular meter rates for the water so used.

If any person shall use water for sprinkling or irrigating from an unmetered service, such service will be shut off and discontinued until ordered turned on by the City Commission on such terms as they may order. This to be in addition to the penalty hereinafter fixed for the violation of this Ordinance.

For all fixtures and uses not mentioned in the above schedule, the City Commission may fix a special flat rate for such fixtures and users or they may require the installation of meters in such services as a condition of the continuance of a supply of water to such service.

Water service to church buildings and grounds proper shall be free and without charge.

The city also at once took steps to secure advice as to some betterments and changes.

In the agreement to sell, the author coupled the requirement, in the interest of the people, that not less than a certain sum should be at once spent for essential improvements, a condition that could scarcely be enforced, yet it had some moral effect and moneys were voted therefor.

It is not only in the small Council Groves of this country, that such conditions as have been described in this paper can obtain, but constant evidence is at hand of similar official thought and behavior in even our largest cities. It seems to be considered that such action carries favor with the mass of the voters.

Such incidents and histories point to a need for wide participation by engineers and utility corporation managers in local and legislative matters, to bring their trained and temperamental fairness to bear upon public education, to the end that mutual justice shall prevail.

Every man should be paid fairly what his services are worth, every business of legitimate nature should be permitted a reasonable return, public utilities whose investment cannot be moved should be guaranteed a living provided their operation is good, and officials should be held accountable for just treatment of corporation as well as voter.

For diagrams and pictures of the Council Grove water plant, other than the one record herewith, reference may be had to the author's two earlier papers of March, 1915, and December, 1918.

POPULARIZING WATER[1]

By Robert E. McDonnell[2]

The business of selling water, whether from private or municipally owned plants, with few exceptions is handled in a manner tending toward bankruptcy and failure rather than toward profits and success, due in a large measure to the failure of the water works officials to consider the public and conduct the water works with the apparent idea that the customers must have the water. Our almost universal practice of ignoring the public is a fault for which we are now paying the penalty.

Just now, at a time when prices for all water works materials and operating costs are mounting higher and higher and increased rates must be secured, the water works officials, whether private or municipal, are forced to turn to the public and conduct a campaign of publicity of water works facts and information before an unfriendly or hostile public opinion. The facts about water, its purity, the plant and its condition are now given out in a defensive attitude, and the lack of familiarity of the consumers with the plant and its needs shows the desirability of keeping before the public an educational campaign of popularizing the water, light, gas, or other utility. This campaign of publicity would have been easier had it been conducted constantly rather than spasmodically in time of stress.

A large proportion of public clamor against a utility is because the public is not posted as to the facts pertaining to the utility and its relation to the welfare of the citizens.

The knowledge and impressions of the public regarding the water works matters are in most cases gained at the water collector's window and through the monthly or quarterly bills mailed out. How many superintendents have ever compared the affability, courtesy, and patience displayed by the clerks selling water with that of the clerk selling dry goods. Can you imagine a clerk in a dry goods

[1] Read before the Iowa Section, November 5, 1920. Discussions are invited and should be sent to the Editor.

[2] Burns & McDonnell, Consulting Engineers, Interstate Building, Kansas City, Mo.

store approaching a customer coatless and with a pipe in his mouth, yet at a water collector's window such a thing is not unusual.

Friends for a municipal water plant are just as important as for a private enterprise, for on the attitude of these friends depends the character of improvements. Appeals to the public for funds must be constantly made. Either new bond issues or tax levies are required in any growing community and the readiness with which the public responds to these appeals depends upon the friendly or unfriendly attitude toward the water works plant and its officials.

A water works official recently made the statement, "We must have new filters, we need new pumps, and we need new mains, but most of all we must have higher rates, but it will be a hard job to convince the public of these necessities because we have silently continued operating, hoping to avoid the necessity of laying our case before the voters."

To criticize without some remedy is easy, but to put into practical use the things helpful to popularize water is not as easy. In making these few humble suggestions the author frankly admits that many of his suggestions may not be new and water officials who are giving a perfect service to a satisfied public are probably already putting in practice many as good if not better ideas than he is able to suggest.

During twenty-five years of engineering in the water works business the author has become a consulting physician to sick water works plants, the first ten years service being largely that of an obstetrician in bringing into life new water works plants, and he must admit that before some of these lusty individuals or plants were of a voting age they had become careless in their ways and decay begun to appear. Many of them lost their nice new clean baby attire and soon needed apparel in keeping with their growth and importance in the community.

As they grew larger and reached out with mains in the residence district seeking friends, they passed by many prospective friends or customers, merely being too backward and modest to stop along the street long enough to make a connection, which is always essential to cement good relations.

In one particular individual or plant, a fourth of the people along the street were passed by with a scornful attitude of mind, saying, come to the office if you want to make my acquaintance. One water works individual of an Indiana city, who prides himself on

the popularity of his management, has discovered that on 100.9 miles of mains there are 2567 vacant lots, or 48 miles of his extensions front vacant property, all suitable for residences.

Every vacant lot passed is a direct loss, although it is a prospective customer whose acquaintance and connection are needed. Statistics show that for towns of the same population some water plants have as low as ten services per hundred people, while others as high as 27 services per 100 people. Out of a list of 31 cities in the S. W. Water Works Association territory, it is found that the connections per mile run from 13 to 87, with an average of 50 per mile. If a city shows less than this average, the superintendent should try to find the remedy and bring his record up to the average.

To revert back to the job of consulting physician to sick water plants, the growth of the plants like that of most young children is all to legs and arms until it becomes awkward, with nothing but extensions and no body, to supply their wants. In a few years the vital parts, such as supply, pumps, reservoirs, etc., are behind the extensions. Then comes a breaking down of the system and a rehabilitation is necessary, which is doubly hard because the public must be told how and why it happened and the sickness of the plant is often one that could be avoided by constantly watching its growth, acquainting the public with the symptoms of its illness, and giving a tonic in the prescription in the way of betterments before the patient goes to the hospital. This can best be accomplished by a complete program of future growth, showing what the plant will need in order to supply its growing condition. Let this program of growth go before the public in every possible way, so there will be no shocks or surprises. The rate of consumption from year to year, the rate of extension of mains, the pump capacity requirements, in fact every feature of the plant can be compared in graphical diagrams and curves showing the plant's needs. Supply them as news items on folders accompanying bills, as cartoons, and on the receipted cards, as for example, Omaha never lets the public forget the saving resulting in the municipal ownership and operation of that plant, for the same rate charge under private ownership is still printed on the cards, and in red ink is printed the reduction in cost of water under municipal ownership.

The most common ailment of water works plants is that produced by permitting impure water to go into the mains. Pure water is an asset that no city can afford to be without. If a city does not have

pure water it is without the essential qualifications of ever making the plant a success. After a pure water supply is established, the publicity regarding its purity should always be kept before the public. The United States Public Health Service has fixed a high standard and when a water plant meets their requirements and sells water for train service this fact should be made known. Photographic bacteria plates illustrating the difference between the raw water and purified water are always convincing and interesting to the public. Bottled waters are often sold where they are inferior to the quality sold from the water works plant. At Bay City, Michigan, recently the bottled water companies carried large display advertisements telling of the bacteria in the city water. At Tulsa it is reported that bottled water sales exceed the revenue from the municipal filter plant. By a campaign of publicity from a city or company having pure water there should not be a drop of bottled water sold.

Milk companies of many cities have recently inaugurated advertising campaigns to popularize milk, giving cartoons showing beautiful and healthful children, attributing everything to pure milk. Their statistics are convincing. The U. S. Department of Agriculture popularizes by cuts, drawings, pamphlets, and photographs before farmers, the need of pure seeds. Pure water has more good sound arguments as a basis for advertising and popularizing it than any other commodity.

The following percentages of increase in the water works materials and labor are derived from figures from more than 100 water works officials in 36 states: Cast iron pipe increase, 245 per cent; special castings increase, 191; lead increase, 88; meters ($\frac{3}{4}$-inch) increase, 37; valves (6-inch) increase, 107; and coal increase, 98 per cent. Average increase in superintendents' salaries, 37 per cent. Average increase in other employees' salaries, 57 per cent.

The alarming feature of the investigation is that 79 per cent of the 100 cities have received no raise of rates, yet practically all of the cities are in urgent need of an increase. Of the 21 per cent of the cities securing a raise of rates, the average increase has been 49 per cent.

The one fact preventing a uniform raise of rates to meet the corresponding increase in other commodities is the lack of knowledge that the public possesses regarding the needs of the plant, its true condition, its value in dollars as a basis of rates and as an asset

to the community. These facts ought to be clearly set forth before the public and kept constantly before the public. If comparisons were made for use of the individual in the costs of all ordinary commodities it would be found that water, although the most essential of all commodities, is the lowest in cost.

If one compares his meat bill, bread bill, fuel bill, picture show bill, or cigar bill with his water bill he will find water the lowest of all.

Water needs popularizing both for the sake of our own health and happiness and for the future success of the water works business. We have now enlisted as a popularizer of water the great Commoner, W. J. Bryan, who recently said:

> All hail to the drink of drinks—to water, the daily need of everything! It ascends from the earth in obedience to the summons of the sun, and descends in showers of blessings. It gives forth its sparkling beauty to the fragrant flowers; its alchemy transmutes base clay into golden grain; it is the radiant canvas upon which the finger of the Infinite traces the rainbow of promise. It is the beverage that refreshes and brings no sorrow with it. Jehovah looked upon it at Creation's dawn and said, "It is good."

DISCUSSIONS

RELATIVE COST OF PUBLIC AND PRIVATE USES OF WATER[1]

LEONARD METCALF: The author's method of distribution of water works expenditures between the domestic and fire protection services has been used in some cases. This method is to subtract from the total reproduction cost of the existing plant the reproduction cost of a plant designed for domestic service alone in order to ascertain the value of the plant used for fire protection. On strictly equitable grounds it is probably fairer to figure the relative costs on the basis of the relative maximum water demand and the water demand for the fire service alone. By Mr. Story's method the benefit of any doubt is given to the city because relatively less is charged to the fire service than to the domestic service. This may be justified on the ground that the general public does benefit by the fire service, as in a congested value district, on account of the greater protection in case of a conflagration. But the method is not so equitable under the ordinary demands for water.

The case of the water supplied to the Industrial School brings home in concrete fashion the danger of paying public bills by giving water service free. Such payments were often made before the public service commission frowned on the practice. The difficulty is that what the future will bring cannot be forecast and there have been many cases where, in the final analysis, under conditions that actually developed, more than an equitable sum has been paid under such an agreement. There have been a number of cases in the more arid regions on the Pacific Coast where the total cost of the water furnished under such a method of purchase has been very high.

WALTER E. MILLER: The writer has always maintained with regard to Mr. Story's method of dividing the investment charges between public and private service, that there was fully as much reason for subtracting the cost of a plant for public service from

[1] Discussion of paper by Stephen B. Story on "The Revenue Chargeable to Public Uses of Water in the City of Rochester, N. Y.;" JOURNAL, November, 1920, page 869.

that of the existing plant and charging whatever balance might remain to the private service, sometimes called the domestic and industrial service. This opinion is based on the many water works possessing a domestic and industrial service of such a character that the plants were apparently built for fire protection primarily. Many of these little works, particularly in the Central States, started off with a very few consumers along the original 8 or 10 miles of pipe, indicating that the primary purpose of the plant was fire protection. In such cases there is more reason in charging public service with so much of the existing investment as would be needed to care for it with a separate plant, with the balance of the investment charged to domestic and industrial service.

The best method is to divide the cost of the existing plant between public and private service on the basis of the relative costs of separate plants for each.

ELECTROLYSIS[2]

GELLERT ALLEMAN: The author cannot recommend any single method of installation as a cure-all for electrolysis, any more than a physician can relieve all diseases by the application of one particular remedy. Every pipe system must be considered individually. There are a number of methods employed in attempts to mitigate the damage done by stray currents. It is stated by advocates of the so-called three-wire system that little damage will result from electrolysis by this means of distribution. These statements are contradicted by facts. In a number of places that the author knows of, the three-wire system is responsible for very serious electrolytic corrosion. Theoretically, this system of distribution is interesting; but, in practice, the adjustments have not been made perfect and the desired electrolytic equilibrium has not been established.

The drainage of pipes by means of copper cables is an important attempt towards mitigating the damage by electrolysis. If a sufficient number of locations are intelligently selected, and a sufficient number of copper cables, having the desired capacity, are

[2] In the discussion of Dr. Gellert Alleman's paper on "Some Aspects of Electrolysis" (JOURNAL, November, 1920, page 882), a number of comments were made which it has as yet been impracticable to obtain in revised form from those making them. The author has, however, contributed the above discussion of the practical points referred to on the floor of the Montreal convention, following the reading of the paper on June 24, 1920.

installed, nearly all of the current is returned over these metallic conductors. The current causes no damage when taken off in this manner. It must be remembered, however, that even with the installation of copper cables, small amounts of current may leak from pipes through the soil at points distant from these cable connections, and electrolysis will result under these circumstances.

Insulated pipe joints should not be installed in localities where electrolytic corrosion may take place. When such installations are made and such a piping system is in a path between some other subsurface structure, for instance, a large water main, the current, in passing through the earth, will get on an insulated section of pipe and is then bound to leave it for the metal having the greater conductivity. In so doing it will corrode the insulated pipe. Such destruction will take place much more rapidly than if the insulated pipe were part of a continuous conductor. In the case of a pipe line made up of insulated sections the current is apt to leave the pipe, through the earth, get on to the next length of pipe, leave it again through the earth, and again enter and leave the pipe many times. Since one ampere, flowing for one year, will dissolve or corrode 20 pounds of iron provided it leaves the pipe but once, when this amount of current leaves the pipe twice it will dissolve 40 pounds of iron; and if it enters and leaves the pipe ten times it will dissolve or corrode 200 pounds of iron.

Recently the author made extensive electrolytic tests in a large city. In order to determine the "drop" on various sections of track, connections were made, at the two track ends, through telephone wires and recording instruments were employed to indicate the differences of potential between the points mentioned. In one case, connections being made 3 miles apart, the track "drop" was 90 volts. An examination of this track showed that workmen were making repairs and numbers of rail bonds were broken. After these rails were properly bonded the same track "drop" was again determined and it was found to be 18 volts. The efficient bonding of the rail is, of course, one of the best safeguards we have. Another suggestion in connection with rail bonding is this: Every time a new power station is put in service the electrical conditions are changed. New power stations and the installation of new tracks should always be accompanied by proper electrolytic protection of the pipe system.

In general, those systems should be employed which will effectively take the current off the pipe through metallic circuits, so that the

current does not leave the pipes through the earth and thus dissolve or corrode the iron or the lead. This can be brought about by proper attention to the electrical continuity of the track by means of the installation of the proper rail-bonds, by a proper regard for the location of feeding stations, and by the judicious use of return cables.

Every pipe system should be considered individually. Conditions may arise within one system which may demand a certain specific method in order to insure protection against electrolytic corrosion. Different conditions may exist in some other pipe system which may be more efficiently protected by the installation of a different mitigating system, or by a combination of a number of systems.

Frequent electrical tests should be made on pipe systems in order to determine whether or not they are receiving proper protection. These examinations should be made at least once a year. If tracks are rearranged, or if new power plants are installed, or the distribution system changed, or additional drainage supplied, electrolytic measurements should be made immediately after such modifications are made.

SOCIETY AFFAIRS

CALIFORNIA SECTION

With an attendance of 75 from all parts of the State, the California Section held its first meeting in San Francisco on Saturday, November 13, 1920. Three papers were presented during the morning session. O. E. Clemens, Water Sales Manager, Spring Valley Water Company, spoke on "The Business End of the Water Works," printed in this issue of the JOURNAL; E. P. McMurtry, Chief Engineer, Krogh Pump & Machinery Company, talked on "The Centrifugal Pump;" and Ralph Hilscher, of the California State Board of Health, told of his experience with "Chlorination in California." These papers were discussed by S. B. Morris, Chief Engineer, Pasadena Water Department; L. M. Anderson, Controller, Public Service Commission; J. P. Fiberling, East Bay Water Company; C. B. Jackson, Superintendent, Fresno City Water Corporation, and others. Forty-nine sat down to the luncheon served at the Engineer's Club, and about the same number enjoyed an automobile trip around the properties of the Spring Valley Water Company.

At the evening session, M. M. O'Shaughnessy, City Engineer of San Francisco, described the formation of the Marin Municipal Water District, a combination of some twelve towns, which were the first to combine under a then recently enacted California law to provide themselves with a domestic water supply.

The following officers were elected for the coming year: Chairman, G. A. Elliott; vice-chairman, L. M. Anderson; Secretary-treasurer, Geo. W. Pracy.

CENTRAL STATES SECTION

The annual meeting of the Central States Section was held in Detroit, Mich., September 28 and 29, with John N. Chester presiding. No report of the meeting having been received from the Section officials up to the time of going to press, the following notes furnished by one of the officers of the Association in attendance are printed here:

The sessions were held at the Stattler Hotel and were attended by 35 to 40 members. All of the papers had evidently been carefully prepared and were listened to with interest. While no program is at hand, one interested member in attendance recalls particularly the following features of the meeting.

T. A. Leisen's paper outlining the great activities connected with the present and future water works problems of Detroit and W. M. Mitchell's very clear and practical talk on the many mechanical aids used in the construction work and maintenance of the Detroit water system were timely and full of useful information. A. H. McAlpine read an enjoyable paper illustrated with lantern slides on the water supply systems of ancient times. C. W. Wiles gave an informal, enjoyable sketch of the beginnings of the Central States Water Works Association, the forerunner of the Central States Section.

In a discussion on water rates and service charges, a subject on which G. C. Gensheimer read an interesting paper, much valuable information was brought out, and in this connection a resolution was passed to the effect that the American Water Works Association be requested to adopt some general system and schedule for charges, including a service charge, to the end that in planning new systems of rates and in urging increased rates, individual water departments and companies might have the backing of a system recommended by the Association.

MINNESOTA SECTION

The eighth meeting of the Minnesota Section, held at Duluth on November 6, was the most successful yet held. There were two sessions, with an attendance of about fifty at each. Water works superintendents were in the majority, but other municipal and state bureaus were represented. The success of the meeting was largely due to D. A. Reed, superintendent of the Water and Light Department of Duluth, who had charge of the local arrangements.

The following papers were presented by their authors and each was well discussed.

"The Production and Sale of Pure Water," by C. J. Sullivan, which is printed in this issue of the JOURNAL.

"The Duluth Water Supply," by E. W. Kelly.

"Water Rates in Small Cities and Villages," by John Wilson, which is printed in this issue of the JOURNAL.

"Water Works Operating Experiences," by Wm. C. Lounsbery.

The following subjects were informally discussed: "The Thawing of Frozen Water Mains," discussion opened by D. Keefe and R. Casson; "Keeping Chlorine Machines in Operation," discussion opened by William McKennitt; "The Uses of Chlorine for the Sterilization of Water Supplies, and Its Effect upon their Potability," discussion opened by Lewis I. Birdsall.

The Section was the guest of the Commercial Club for luncheon, and the afternoon was spent in visiting points of interest.

The following resolutions were passed:

Resolved, (1) That a committee be appointed to consider the publicity of the Minnesota Section; this committee to consist of three members to be appointed by the Chairman.

(2) That the Minnesota Section of the American Water Works Association in convention assembled desires to express its appreciation of the Division of Sanitation, Minnesota State Board of Health, for its excellent work in the safeguarding of the water supplies of the state and the consequent reduction of water-borne diseases, especially typhoid fever. The Minnesota Section respectfully requests the Minnesota State Legislature to increase the present appropriation for the Division of Sanitation sufficiently so that the valuable assistance given to the communities in the state will be adequate for the elimination, in so far as possible, of water-borne diseases.

The Minnesota Section hereby instructs the Chairman to send copies of this resolution to the committees on appropriations and public health in the State Senate and Assembly, and to the Governor of the State.

IOWA SECTION

The sixth annual meeting was held at Iowa City, Iowa, on November 5 and 6, with Vice-Chairman F. D. H. Lawlor presiding in the place of Chairman George E. Shoemaker, absent for a cause hinted at in the following telegram sent to him by authority of a resolution passed at the opening session: "The Iowa Section wishes to express its regret at your absence and to assure you of its deep sympathy with you in your loss. Jack J. Hinman, Jr., Secretary."

At the morning session on November 5, after the addresses of welcome and acknowledgment, the following subjects were informally discussed:

"Financing Water Main Extensions," discussed by Charles R. Henderson, Davenport, Iowa; William Molis, Muscatine, Iowa; J. W. McEvoy, Dubuque, Iowa; Robert B. Wallace, Council Bluffs, Iowa; Col. Dabney H. Maury, Chicago; C. M. Baker, Madison,

Wis.; William Luscombe, Gary, Ind.; George T. Prince, Omaha, Neb.; J. Chris Jensen, Council Bluffs, Iowa; Robert E. McDonnell, Kansas City, Mo.; Andrew Kydd, Cedar Rapids, Iowa; F. M. Johnson, Terre Haute, Ind.

"Cleaning Water Mains," discussed by Charles F. Fox, Oskaloosa, Iowa, the discussion being closed on account of lack of time for continuing it.

At the afternoon session of November 5 the following papers were read:

"Tropical Water Supplies," by Prof. D. M. Griswold.

"Further Observations on the Eosine-Methylene-Blue Agar," by Capt. Max Levine, discussion by Col. Edward Bartow, Dr. Henry Albert and Joel I. Connolly.

"A Self-Cleaning Underground Water-Collecting System," by George T. Prince, discussed by Robert E. McDonnell, Colonel Bartow, H. S. Nixon, Lafayette Higgins and Charles F. Fox.

"Pumpers or Triple Combination Chemical Engines," by William Molis, discussed by Thomas Healey, W. T. Birch, Charles R. Henderson, Homer V. Knouse, H. F. Blomquist, Col. Dabney H. Maury and Charles F. Fox.

"Valuations of the Iowa City Water Company on Present and Pre-War Costs," by Prof. John R. Dunlap, discussed by George T. Prince, Colonel Maury, Robert E. McDonnell and Robert B. Wallace.

After supper at the rooms of the Commercial Club the following papers were presented.

"Popularizing Water," by Robert E. McDonnell, discussed by Robert B. Wallace and Homer V. Knouse. The paper is printed in this issue of the JOURNAL.

"Progress on the Dayton Flood Control Project," by Prof. Sherman M. Woodward.

After moving pictures of excavating machinery had been shown, the balance of the evening was spent as a smoker.

The papers at the morning session of November 6 were as follows:

"The Application of Copper Sulphate to Basin Walls for the Control of Algae," by George F. Gilkison, discussed by Charles R. Henderson, George T. Prince, Wm. Molis, H. F. Blomquist, Colonel Bartow, G. C. Habermeyer and J. W. McEvoy. The paper is printed in this issue of the JOURNAL.

"Value versus Investment as a Basis for Utility Service Rates," by William G. Raymond, discussed by George T. Prince, J. H. Dunlap, Robert B. Wallace and Robert E. McDonnell.

"State Provision for Water Supply Control," by Capt. Jack J. Hinman, Jr.

The Special Committee on the State Water and Sanitary Survey submitted the following report, which was unanimously adopted:

"An abundant supply of pure water for drinking and manufacturing purposes should be provided in all parts of the State. This supply should be protected and maintained.

"The Iowa Section of the American Water Works Association, in convention assembled, approves the formation of a complete State Water and Sanitary Survey for Iowa.

"The formation of such State Water and Sanitary Survey should be referred to the Legislative Committee by the Section to act with other like committees in support of the plan and in drafting a bill to be presented to the Legislature.

"The Secretary of the Section should inform the incoming and outgoing governors and both branches of the 39th General Assembly at the proper time of the action herewith taken and request an adequate appropriation for the organization and maintenance of the Survey."

The Legislative Committee made a report on bills considered by it and on its other activities. The bills were discussed and finally referred to the Committee with power to act. The Committee was authorized to confer with similar committees of the Iowa League of Municipalities and the Iowa Engineering Society.

The following officers were elected: Chairman, F. D. H. Lawlor, Burlington, Iowa; vice-chairman, J. Chris Jensen, Council Bluffs, Iowa; directors, R. E. McDonnell, Kansas City, Mo., and Homer V. Knouse, Omaha, Neb. The Executive Committee reappointed Capt. J. Hinman, Jr., Iowa City, secretary and treasurer.

NEW YORK SECTION

The first meeting of the Section was held at the Hotel McAlpine on October 20, with Chairman W. W. Brush presiding and an attendance of about ninety. After luncheon Prof. George C. Whipple gave an informal talk on the work of the Red Cross in sanitary fields in Europe.

On December 1, about 60 members and guests visited the pumping station and purification plant of the Hackensack Water Company at New Milford, N. J.

ADDITIONS TO THE MEMBERSHIP

Active Members

Hilton S. Bragg, Engineer, The Pitometer Company, Detroit, Mich.

John A. Bruce, Consulting Engineer, Omaha, Neb.

Cecil K. Calvert, Indianapolis Water Company, Indianapolis, Ind.

William L. Clark, Chemist, Filter Plant, Wyandotte, Mich.

Harry T. Campion, Superintendent Water Works, Defiance, Ohio.

O. W. Carrick, Water Engineer, Wabash Railway, Decatur, Ill.

Charles J. Fox, Superintendent Water Company, Oskaloosa, Iowa.

Robert F. Gadd, President, Board of Water Commissioners, Hartford, Conn.

Hans Graff, Junior Engineer, U. S. Engineer Office, San Francisco, Cal.

Joseph John Greene, Supervising Engineer, Public Works Department, Sydney, Australia.

Daniel Cornelius Grobbel, Cashier, Board of Water Commissioners, Detroit, Mich.

Franklin Henshaw, Village Engineer and Street Commissioner, Scarsdale, N. Y.

Alfred Dewey Horne, Superintendent Water Works and Lighting, Fairmount, Minn.

Herbert M. Johns, Superintendent Hanford Water Company, Hanford, Cal.

William Allen Jones, Assistant Engineer, Pitometer Company, Detroit, Mich.

Morgan F. Larson, City Engineer, Perth Amboy, N. J.

T. C. Mellersh, Vice-president and General Manager, Russian River Water Company, San Francisco, Cal.

Arthur P. Miller, Assistant Sanitary Engineer, U. S. Public Health Service, Louisville, Ky.

James J. Mitchell, Superintendent Water Company, Warren, Pa.

George Sumner Nickerson, Hydraulic Engineer, Sacramento, Calif.

R. N. Perkins, Consulting Chemist and Bacteriologist, Omaha, Neb.

Manley J. Ranken, Assistant Engineer, Detroit Water Board, Detroit, Mich.

J. Sheldon Scott, Chemist in Charge, Water Purification Plant, Steubenville, Ohio.

PROGRAM FOR ANNUAL CONVENTION

The program for the annual convention at Cleveland is now being drawn up. Suggestions regarding topics for discussion and particularly regarding papers on any feature of water supply are invited. Members are urged to send these suggestions at once to the Chairman of the Publication Committee, Wm. W. Brush, Deputy Chief Engineer, Department of Water Supply, Gas and Electricity, Municipal Building, New York, N. Y.